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DOCTOR OF PHILOSOPHY

The role of the native language in second-language syntactic processing

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Gunnar Jacob

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**The Role of the Native Language in
Second-Language Syntactic
Processing**

Gunnar Jacob

Thesis submitted for the degree of PhD

University of Dundee, September 2009

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DECLARATION

I, Gunnar Jacob, hereby certify that I am the author of this thesis. It is a record of my own work. All of the work contained in the thesis has been carried out by me, and none of it has previously been accepted for a higher degree.

Gunnar Jacob

Date:

And the Lord said (...) “Behold, they are one people, and they have all one language; and this is only the beginning of what they will do; and nothing that they propose to do will now be impossible for them. Come, let us go down, and there confuse their language, that they may not understand one another’s speech.”

So the Lord scattered them abroad from there over the face of the earth, and they left off building the city. Therefore its name was called Babel, because there the Lord confused the language of all the earth (...)

- Genesis 11.

Abstract

The present thesis investigates in how far properties of a reader's first language (L1) have an influence on syntactic processing in a second language (L2). While the Competition Model (Bates & MacWhinney, 1982, 1987, 1989, MacWhinney, 1997) predicts that syntactic properties of the L1 can have an influence on L2 processing, the Shallow-Structure Account (Clahsen & Felser, 2006) suggests that an L2 speaker's representation of an L2 sentence is shallower, lacks syntactic detail, and is therefore not detailed enough for properties of the L1 to have an influence on L2 processing (Papadopoulou & Clahsen, 2003). In two sets of studies, I investigate whether L2 speakers of English activate syntactic information from their L1 while processing English sentences. In Experiments 1-4, native speakers of German, and control groups of native speakers of French and English, are confronted with English sentences consisting of a word order which exists in both English and German, but which represents different underlying syntactic structures in both languages. Results suggest that native speakers of German activate syntactic information from their L1 while reading such sentences. Experiments 5-7 represent an attempt to address both the issue of L1 influence and the issue of shallow processing within the context of the same experimental design. Native speakers of German, and a control group of native English speakers, read grammatically incorrect English sentences with a word order which would either be grammatically correct in German, or grammatically incorrect in both English and German. In this set of experiments, we found evidence against an influence of syntactic properties

of the L1. Results also suggest that contrary to the predictions of the shallow-structure account, L2 speakers fully parse the syntactic structure of an L2 sentence, and compute detailed syntactic representations.

CHAPTER 1

Introduction

Arguably one of the first documented examples of a case of cross-linguistic syntactic transfer is from Werner Leopold. A German linguist who had migrated to the United States in 1925, Leopold was fascinated by the bilingual development of his daughter Hildegard, and wrote down a lot of his daughter's utterances in his diaries. In 1936, after 5-year-old Hildegard had just returned from an extended stay in Germany, he observed a number of cases where Hildegard used German grammar in an English sentence, documented them, and attached a personal comment:

"Then is here your school. (...) We play now this. (...) Which grade is man in when man 9 years old is?"

- German word-order in the subordinate clause! This is very unusual.

In a number of sentences, Leopold's daughter had incorrectly used German word order in English sentences. In this respect, the diary note raises the question in how far the properties of a speaker's native language (L1) have an influence on processing and production of sentences in a foreign language (L2).

In other areas of language processing, most notably word recognition and lexical access, it is generally considered uncontroversial that properties of the L1 have an effect on L2 processing. In the area of syntactic processing, however, this question has been subject to considerable debate over the past 25 years, with researchers coming to radically different conclusions regarding

the issue. Just to illustrate how controversial the possible existence of such effects is discussed, let us have a look at a number of quotes:

- “no evidence of transfer involving grammatical word-order”
(Rutherford, 1983, quoted from Hakuta, 1986)
- “Even in structural areas (...) clear evidence for transfer can be found.” (Ellis, 1994)
- “Papadopoulou & Clahsen's (2003) study (...) provides strong evidence against the transfer of L1 processing strategies.” (Clahsen & Felser, 2006)
- “(...) there is activation of L2 knowledge in memory during the process of L1 sentence parsing.” (Dussias & Sagarra, 2007)
- “Bilinguals can sometimes adopt L2 structures as if they were native speakers of the L2, but in other contexts they are influenced by transfer from the L1 (...)” (Schwartz & Kroll, 2006)

The above quotes represent radically different opinions regarding the role of the L1 in L2 syntactic processing: While Clahsen & Felser (2006) and Rutherford (1983) argue against an influence of the L1 on the syntactic level, Ellis (1994) assumes the opposite standpoint. Dussias & Sagarra (2007) even go one step further, arguing that properties of an L2 in which a speaker is

proficient can even influence the way this speaker processes sentences in his native language. Finally, the quote from Schwartz & Kroll (2006), while refusing to adopt a clear standpoint, can probably be considered a fitting description of the current state of the field.

Terminology

Terms such as *transfer*, *interference*, and *cross-linguistic influence* have been subject to a considerable amount of debate for the past 25 years (e.g. Dulay, Burt, & Krashen, 1982, Sharwood-Smith & Kellerman, 1986; Ellis, 1994). This has sometimes led to confusion and misunderstanding.

The term *interference* is used in both Psycholinguistics and Sociolinguistics, but has a different meaning in each of these two disciplines: In Psycholinguistics, the term is used to refer to “the influence of old habits when new ones are being learned” (Dulay et al, 1982): The individual tries to acquire an L2 rule, but experiences problems because there is already an L1 rule. In Sociolinguistics, the same term refers to phenomena that occur when an individual lives in a place where he is frequently exposed to more than one language.

The term *transfer* was originally closely connected to the traditional behaviourist perspective on the issue, and is therefore not theory-neutral. Odlin (1989, quoted from Ellis, 1994) proposed a more theory-neutral definition of the term:

“Transfer is the influence resulting from the similarities and differences between the target language and any other language that has been previously (and perhaps imperfectly) acquired.”

Note that in this definition, it is not necessarily the L1 which influences L2 processing: It is also possible that the influence comes from other languages the individual is proficient in. Note also that the “target language” is not necessarily the L2: It is also possible that properties of an L2 affect L1 processing; in this case, the target language is actually the L1. While it is controversial whether properties of an L2 can actually have an effect on native-language processing, this has been suggested (see Dussias, 2003; Dussias & Sagarra, 2007; in Chapter 4).

Odlin’s definition of *transfer* only includes cases where the target language is influenced by the fact that a certain property of it differs or is similar to another language. This, however, excludes cases where the processing of the target language is influenced not by *properties* of another language, but by the very *existence* of another language in the cognitive system: E.g., it is not impossible that dealing with two languages causes additional processing load. This might force the processor to use other, less demanding processing strategies (Dussias 2003, see Chapter 4). Sharwood-Smith & Kellerman (1986) have proposed the broader term *cross-linguistic influence* as a theory-neutral term that includes such effects as well.

In the past 15 years, the majority of published research regarding the issue has used the term *transfer*. However, because of the above-mentioned theoretical problems related to the term, I will refer to phenomena involving a possible role of the L1 in L2 processing as effects of *L1 influence*.

A bit of History

As already mentioned, the idea that the native language of an individual has some sort of effect on the way this individual processes and produces sentences from a foreign language is far from new. Actually, in the form of an approach called *contrastive analysis*, this idea dominated the first two decades of L2-acquisition research following world war two. Influenced by behaviourist learning theories, the native language was thought of as a set of *habits* acquired through classical and operant conditioning. As Brooks (1960) puts it:

“The single paramount fact about language learning is that it concerns (...) the formation and performance of habits.” (quoted from Ellis, 1994)

In this context, the term *habit* is defined as a set of responses to a present stimulus. The connection between stimulus and response is not acquired through strategic thinking, but through automatic association between stimulus and response. Thus, the habit is automatically activated whenever the corresponding stimulus is encountered.

To explain why native-language influence is so central in this kind of approach, let us have a look at an example: Assume a native speaker of

English has a conversation in a second language, Gaelic, in which he is not very fluent yet. The person our L2 speaker talks to asks a question and stops talking. From a behaviourist point of view, this can be regarded as a *stimulus* that requires a specific *response*, in this case, the production of a sentence by our L2 speaker of Gaelic. Gaelic is a verb-first language, so the correct *response* would be to start the sentence by producing a verb. The native language of the speaker, however, is English, which uses subject-verb-object word order. During native-language acquisition, the speaker learned through association that the correct response would be to produce a subject before the verb. Within the context of the contrastive analysis approach, this association is considered to be automatically activated whenever the stimulus is encountered. What has been learned during native-language acquisition automatically gets in the way during the production of an L2 sentence.

As a result, the contrastive analysis approach considers overcoming native language habits the primary problem in L2 acquisition, processing and production. On the basis of this assumption, areas where a particular L2 speaker will likely experience difficulties can be identified by a careful comparison –a *contrastive analysis*– between the linguistic features and rules of the L1 and L2. The approach predicts that if the two languages are very similar, an L2 speaker will experience less difficulty, than in a case where the L1 and L2 are very different.

In the 1970s, the approach gradually fell out of favour for a number of reasons. First, as a result of the Skinner-Chomsky debate (e.g. Skinner, 1959; Chomsky, 1967), it became clear that explaining language learning within the framework of behaviourist learning theories was not without problems.

Second, empirical studies investigating typical errors of L2 learners presented evidence against some of the central claims of the approach. In a classical study, Dulay & Burt (1974) found that only a small minority of the errors were transfer errors (i.e. errors that matched properties of the L1), while the vast majority of errors were developmental errors (i.e. errors that an L1 speaker is also likely to make during L1 acquisition). Other studies (e.g. Jackson & Whitnam, 1971) showed that many errors predicted by a comparison between the rules of the L1 and L2 actually never occurred. In short, these studies claimed to show that the contrastive analysis approach possessed only very small predictive power with respect to typical errors of L2 learners. While these studies were later severely criticized on methodological grounds (most notably the definitions of what exactly counts as a developmental and what as a transfer error; see Hakuta (1986) for a more detailed review), contrastive analysis was slowly falling out of favour. As Hakuta (1986) puts it:

“Yet the willingness to put contrastive analysis on such a hastily and poorly executed trial indicated that times had changed, that the habit view was out.”

Before moving on to review current research on L2 processing, a number of central issues concerning the above shall be mentioned.

On a theoretical level, L1 influence was primarily looked at on the basis of behaviourist learning theories. When it was shown that the application of these theories to language learning was actually extremely problematic (Chomsky, 1967), this resulted in scepticism concerning L1

influence as well. This discussion about the components of the theoretical model, however, is in principle independent of a discussion about L1 influence: L1 influence is an observable effect, while the explanation of this effect in terms of a theoretical model is a second issue. If a proposed theoretical model turns out to be problematic, this is not evidence against a role of the L1 in L2 processing, but only evidence against a specific theoretical model that explains and predicts such effects.

On a methodological level, it should be mentioned that almost all empirical studies mentioned above investigated L1 influence by looking at errors of L2 speakers. This is understandable, as research on L2 processing is relatively close to applied questions of L2 learning, and language teachers are naturally interested in reducing the number of mistakes their students make. It is possible, however, that errors are a relatively rough measure of difficulty: Just because an L2 speaker manages to understand or produce a particular L2 sentence correctly, this does not necessarily mean that he experienced no difficulty. Instead, it might simply be that the speaker experiences L1 influence, but is still able to avoid a mistake by putting additional effort or time into the task. The experimental studies reviewed in the next chapter differ in this respect: Instead of errors, they normally employ more sensitive measures of difficulty, such as reading times, eye movements, or brain potentials.

CHAPTER 2

Accounts and frameworks of L2 syntactic processing

Several attempts to develop comprehensive frameworks of L2 processing have been proposed. In the following, I discuss two such accounts, which are relevant to the issue of L1 influence in the sense that they make clear, and also directly opposing, predictions regarding a possible role of the L1 in L2 syntactic processing.

The Competition Model

An older account of L2 processing, which has received considerable attention in the past 20 years, is the Competition Model of Bates and MacWhinney (1982, 1987, 1989).

The model is based on the assumption that all sentence processing, no matter whether in the L1 or L2, requires a reader to solve two basic tasks:

First, a reader must determine the *cue validity* of each piece of information contained in a sentence. In other words, it is necessary to determine which pieces of information in a sentence are particularly valuable for parsing. This differs between languages: E.g., German is relatively rich regarding morphological markings which clarify syntactic functions of particular words. Thus, morphology is a strong cue, and relatively helpful for determining the syntactic structure of a German sentence. On the other hand, German word order is relatively free. As a result, word order, while still useful to some extent, is a relatively weak and unreliable cue for the underlying syntactic structure of a sentence. In English, however, this is the other way round: English possesses relatively strict word order rules, so in English, unlike in German, word order is a particularly useful cue for determining the syntactic structure of a sentence. However, English is not as

rich as German regarding morphological cues which contain syntactic information, so morphological information is considerably less useful for syntactic parsing than in German.

Second, a reader has to determine the *cue cost* of each piece of information that the sentence contains. E.g., for a particular sentence, word order might be relatively easy to process (low *cue cost*), while the morphological information in this particular sentence might be very complex, and might thus require additional processing resources (high *cue cost*).

The Competition Model assumes that a reader distributes his available processing resources to the different bits of information contained in the sentence, based on cue validity and cue cost: Bits of information which are either particularly useful, particularly easy to process, or both, should receive more processing resources than those which are less useful, or those which are hard to process.

For L1 syntactic processing, the Competition Model predicts clear differences between native speakers of different native languages. E.g., native speakers of English reading English sentences should primarily rely on word order cues (a reliable/useful cue in English), at the expense of morphological information (a less useful/reliable cue in English). Native speakers of German reading German sentences, however, should attribute most processing resources to morphological cues, and rely less on word order information. The predictions the Competition Model makes for L1 processing have extensively been tested for a number of languages (see Hernandez, Fernandez, and Aznar-Bese, 2007, for a review), generally confirming that native speakers generally

rely most on cues possessing high cue validity in their respective native language.

Competition Model and L1 influence

The Competition Model assumes that sentence processing routines are language-independent. In other words, it is assumed that an individual possesses only a single sentence-processing system, which can operate on any language. E.g., a native speaker of English reading German sentences is assumed to experience L1 influence in the sense that he relies on word-order to a larger extent than a native speaker of German would, because in his native language (English), word order is a particularly useful cue (high cue validity). In MacWhinney's own words, "all aspects of the first language that can possibly transfer to L1 will transfer. This is an extremely strong and highly falsifiable prediction. However, it seems to be in accord with what we currently know about transfer effects in second language learning." (MacWhinney, 1997).

The Competition Model: Results

A number of studies have tested this central prediction of the competition model using a methodological approach called the sentence-interpretation paradigm. Participants are confronted with L2 sentences which consist of two nouns and a verb, and are subsequently asked a question related to the syntactic structure of the sentence, such as to identify the agent

or the patient. By experimentally manipulating specific cues, such as morphological information or word order, it is possible to measure in how far these cues influence a participant's answer to the task.

In a classical experiment, Kilborn (1987, 1989) showed native speakers of German English sentences consisting of two nouns and a verb, and asked them to identify the agent. Within the sentences, he experimentally manipulated three types of cues which were potentially useful to identify the agent: Animacy, subject-verb agreement (morphology), and word order. In accordance with the predictions of the Competition model, results showed that the German participants mainly relied on animacy and subject-verb agreement to identify the agent, at the expense of word order. This was expected, given that in L1 German, word order is an unreliable cue for the syntactic structure of a sentence.

In a similar study, Hernandez, Bates, and Avila (1994) asked a group of late Spanish/English bilinguals, and two control groups of native speakers of English and Spanish, to identify the agent in English and Spanish sentences containing two nouns and a verb. Just as Killborn (1987, 1989), they also manipulated animacy, subject-verb agreement, and word order within these sentences, and measured reaction times and the chance to select the first noun in the sentence to determine in how far these 3 variables influenced a participant's answers. Spanish, just as German, possesses relatively free word order, but a rich morphology. The authors found that native speakers of English relied mainly on word order to identify the agent, while native speakers of Spanish relied almost entirely on subject-verb agreement. The group of Spanish/English bilinguals, however, showed a mixed pattern,

relying both on subject-verb-agreement and on word order, for both Spanish and English sentences. In accordance with the Competition Model, the authors argue that the bilingual participants were influenced by properties of Spanish while reading the English sentences, and vice versa.

The Competition Model is dynamic in the sense that the language processing system is considered to consistently re-evaluate cue-validity and cue strength of various cues while encountering new language input. As long as the learner's L2 proficiency is still relatively low, he will transfer cue validity and cue cost from his L1. For learners with a higher proficiency, who have already come across a considerable amount of L2 input, this might change towards a more "amalgamated" pattern: E.g., if word order has a high cue validity in the L1, while subject-verb agreement has a high cue validity in the L2, a highly proficient L2 speaker would be expected to rely on both word order and subject-verb agreement while processing sentences in the L2. This assumption of the model was tested in a longitudinal study by McDonald (1989). Native speakers of English learning French participated in a sentence-interpretation study, in which they read French sentences. Each participant was tested twice, once after two semesters of learning French, the second time in their fourth semester. After two semesters, the data pattern was determined by properties of L1 English, with participants relying mainly on cues possessing a high cue validity in L1 English, such as word order. Results for the fourth semester, however, showed a more "amalgamated" data pattern, with participants relying both on cues with a high cue validity in their L1, and on cues with a high cue validity in their L2.

The Shallow-Structure Account: Introduction

Another account of L2 syntactic processing is the so-called shallow-structure account, proposed by Clahsen & Felser (2006). The account is based on the assumption that the representations that an L2 speaker builds during comprehension lack syntactic detail, and are in that respect “shallower” than those of a native speaker. In more precise terms, the account predicts that a number of syntactic phenomena, which affect sentence processing in native speakers, do not do so in L2 speakers, because the particular syntactic phenomenon is not processed in L2 processing. To illustrate what exactly this means, it is useful to have a look at one of the first experimental studies conducted to test the account. Marinis, Roberts, Felser, & Clahsen (2005) investigated how L2 speakers processed sentences containing a type of filler-gap dependency shown in sentence (1a) below:

- (1a) The nurse who the doctor argued ____ that the rude patient had angered is refusing to work late.
- (1b) The nurse who the doctor’s argument about the rude patient had angered is refusing to work late.
- (1c) The nurse thought the doctor argued that the rude patient had angered the staff at the hospital.
- (1d) The nurse thought the doctor’s argument about the rude patient had angered the staff at the hospital.

In sentence (1a), the phrase *that the rude patient had angered* refers to *the nurse*. At *had angered*, the parser has to determine which constituent the

phrase refers to. The task of establishing the connection between the phrase *had angered* and the subject *the nurse* is made more difficult by the fact that the sentence contains another relative clause (*who the doctor argued*) which increases the distance between the two constituents. In order to solve the task of connecting the filler and the gap, the parser has to keep the filler *the nurse* activated until it reaches the gap where the filler is needed. Sentence (1a) differs from sentences (1b)–(1d) in the sense that it also contains an *intermediate gap* after *argued* (marked by “___” in sentence (1a) above). At this intermediate gap, the parser has the opportunity to re-activate the filler *the nurse*. If the parser reactivates the filler at this intermediate gap, this might actually make processing of the verb phrase *had angered* easier, because the parser only needs to go back to the intermediate gap, rather than to the beginning of the sentence, to determine what constituent *had angered* refers to. In other words, processing the segment *had angered* should be facilitated by the presence of an intermediate gap in sentence (1a), which should result in a significant interaction between Extraction (intermediate gap vs. no intermediate gap) and phrase type (NP vs. VP). In a self-paced-reading study, Marinis et al. (2005) found such an interaction at *had angered* for native speakers of English, but not for L2 speakers. Additionally, they also found that native speakers showed longer reading times for the complementizer *that* in sentence (1a) than in control sentence (1c), while L2 speakers showed no difference, indicating that native speakers indeed reactivated the filler at this point during parsing, while L2 speakers did not. Based on these results, the authors argue that native speakers compute the intermediate gap after *argued* in sentence (1a), and re-activate the filler the

nurse at this point, which makes it easier to again re-activate the filler later in the sentence, at *had angered*. L2 speakers, however, do not compute the intermediate gap, and thus show no interaction. The authors conclude that an L2 speaker's representation of the syntactic structure of the sentence is more "shallow" in the sense that certain syntactic features, such as intermediate gaps, are missing, and thus cannot be utilized to solve tasks such as establishing the connection between the filler the nurse and the gap after *had angered*.

The Shallow-Structure-Account: How shallow is "shallow"?

The study described above suggests that L2 speakers are unable to process and utilize one fairly specific syntactic property, namely an intermediate gap. Based on the results of Marinis et al. (2005) alone, it would still be possible to argue that L2 speakers basically process syntactic information in the same way as native speakers, and only differ from them when it comes to very specific, highly complex, and relatively rare syntactic phenomena, such as intermediate gaps. The shallow-structure account, however, goes beyond such a more conservative interpretation of the results presented above, and assumes that intermediate gaps are just one example of many syntactic properties which L2 speakers are unable to compute. Clahsen & Felser (2006) suggest that L2 speakers only process syntactic information in a very rudimentary way, and instead assign thematic roles directly to the various constituents of a sentence, based mainly on semantic information. In other words, L2 speakers

are considered to puzzle together the constituents of a sentence in a meaningful way, mainly based on semantic cues, and ignoring syntactic cues. Such a semantics-based sentence-processing mechanism fits in well with the strengths and weaknesses of an L2 speaker: On the one hand, an L2 speaker possesses the same amount of world knowledge as a native speaker, allowing him to utilize semantic information very effectively. On the other hand, an L2 speaker possesses considerably less experience in processing syntactic information from the L2.

Before I move on to discuss the predictions the shallow-structure account makes for possible effects of L1 influence, an important problematic aspect of the account has to be discussed: The account is underspecified in terms of what exactly the term “shallow” means, and what range of phenomena it applies to. While the account assumes that an L2 speaker mainly assigns thematic roles directly on the basis of semantic information, it still allows for “rudimentary” syntactic processing as well. This makes it particularly difficult to falsify the account empirically: Whenever an empirical study finds that L2 speakers do process a specific type of syntactic information, this would just be assumed to be one of those syntactic properties that “rudimentary” syntactic processing is still able to deal with. Whenever a study shows that a specific type of syntactic information is not processed or utilized by L2 speakers, this would be interpreted as evidence supporting the account. Thus, in order to make the model empirically falsifiable, it is necessary to specify what aspects of syntax are still processed during “rudimentary” syntactic processing, and what other aspects of syntax cannot be processed by L2 speakers.

Shallow-Structure Account and L1 influence

While the Shallow-Structure Account is underspecified in terms of the meaning and scope of the term “shallow”, it still makes clear predictions regarding a possible role of the L1 in L2 syntactic processing: According to the account, L2 speakers compute only a very rudimentary representation of the syntactic structure of an L2 sentence. The authors consider this representation to be not detailed enough for effects of L1 influence to occur. To quote the authors: “For structure-based ambiguity resolution strategies to be transferred, a sufficient amount of structure must be present in the first place, and this must be of a form that allows the syntactic processor to operate on it.” (Clahsen & Felser, 2006). In other words, syntactic properties of the L1 can only have an influence on L2 processing if the L2 parser actually computes a proper representation of the syntactic structure of the sentence. The shallow-structure account assumes that an L2 parser does not compute such a proper representation, so the L1 should not have any effect on L2 parsing. The authors refer to a study by Papadopoulou & Clahsen (2003), reviewed in the Chapter 4 below, as evidence supporting their account.

It is useful to discuss a number of general properties of the shallow-structure account. First, while the account predicts that the L1 does not play a role in L2 *syntactic* processing, it allows for L1 influence effects on other levels of language processing. The authors assume that L1 and L2 processing are qualitatively different regarding syntactic parsing, but not regarding lexical or semantic processing. As a result, the account is consistent with effects of the L1 on the level of lexical processing, such as effects of the L1

often found in the processing of cognates or homographs. Thus, an experimental study testing the predictions of the account has to prove that the effects are actually syntactic, and cannot be explained by L1 influence on other levels of language processing.

Second, the possibility that readers sometimes process syntactic structures only shallowly has not only been proposed for L2 processing, but also for L1 processing. In this respect, the authors explicitly refer to the good-enough-sentence-processing-account (e.g. Ferreira, 2003; Ferreira, Ferraro, & Bailey, 2002), which assumes that native speakers also sometimes process syntactic structures only shallowly. E.g., in one of their studies, Ferreira & Stacey (2000) showed native English participants sentences such as (2a) – (2d), and asked them to indicate whether the event described in the sentence was plausible or not:

- | | | |
|------|--------------------------------|------------------------|
| (2a) | The man bit the dog. | (active, implausible) |
| (2b) | The man was bitten by the dog. | (passive, plausible) |
| (2c) | The dog bit the man. | (active, plausible) |
| (2d) | The dog was bitten by the man. | (passive, implausible) |

Results showed that for implausible sentences such as (2a), participants had little difficulty noticing its implausibility. Sentences such as (2d), however, were often incorrectly considered plausible. The authors argue that in the case of sentences such as (2d), native speakers sometimes ignore syntactic information, and instead assign thematic roles directly.

Thus, the shallow-structure account does not claim that shallow processing is a unique property of L2 processing. Instead, Clahsen & Felser (2006) argue that while native speakers can choose whether they perform a full parse of the syntactic structure of a sentence, or whether they process syntactic information only shallowly, L2 speakers are unable to perform a full parse, and are restricted to shallow processing.

Third, the fact that the shallow-structure account predicts null effects regarding a possible influence of the L1 is problematic for methodological reasons: Statistical null effects cannot be interpreted, so if a study shows no effects of L1 influence, this cannot be considered evidence supporting the account. I get back to this particular problem in the results section below, in which I present a set of experimental studies trying to avoid this problem, by using stimuli for which the account does not predict null effects.

Competition Model and Shallow-Structure Account: A comparison

The two accounts mentioned above differ in a number of ways: First, both accounts make dramatically different predictions regarding effects of the L1 in L2 processing: While the shallow-structure account assumes that all L2 syntactic processing, independent of the particular L1 background of the speaker, shares basically the same properties, the Competition Model predicts that especially a beginning learner will experience a strong influence of the L1 on all levels of processing. In this respect, investigating the role of the L1 in L2 syntactic processing represents particularly fertile ground for a comparison

between the two accounts, because this is an area in which the two accounts make directly opposing predictions. Second, while both accounts can quote empirical studies confirming their predictions, the research traditions linked to the two accounts are very different from each other. While the shallow-structure account is mainly concerned with effects in real-time sentence processing, research on the Competition Model concentrates mainly on the final interpretations of readers. As result, it is only natural that research on the shallow-structure account uses on-line measures such as reading times, while research on the Competition Model consists mainly of off-line measures such as sentence interpretation. Any direct comparison between the two accounts has to take these different methodological traditions into account, ideally by combining both on-line and off-line measures within the context of the same experiment. I intend to get back to this issue in the methods section below, when I present the second set of experiments.

CHAPTER 3

Syntactic Representations in L2 Speakers

One important area of research regarding L2 syntactic processing addresses the question how the various L2 structures that an L2 speaker has learned are represented in memory. With respect to the role of the L1 in L2 processing, this includes the question whether each L1 and L2 structure that a speaker has learned is stored in memory as a separate entry, or whether structures which are identical (or at least sufficiently similar) in the L1 and L2 are stored as a single, shared memory representation. One possible method to study this question, which has received considerable attention in recent years, is the use of paradigms involving cross-linguistic syntactic priming.

Syntactic Priming

The term “syntactic priming” refers to an effect discovered by Levelt & Kelter (1982): During the production of a sentence, speakers tend to repeat syntactic structures they have produced or processed shortly before. Within monolingual psycholinguistic research, the effect has been used extensively in a number of studies, particularly to investigate processes of syntactic-ambiguity resolution. One classical example of such a study is Bock (1986). Participants were asked to repeat auditorily presented prime sentences, and subsequently had to describe a picture. In one set of conditions, the prime sentences were either active or passive. Bock found that the syntactic structure used in the prime sentence influenced what syntactic structure participants subsequently used to describe the picture: After passive primes, participants were more likely to use a passive sentence to describe the picture than after active primes. In a second set of conditions, the prime sentences contained either prepositional-object or double-object constructions. Again,

results showed that participants tended to use the same syntactic structure as in the prime sentence to describe the target picture.

Why is syntactic priming useful for research on L2 processing? The basic idea is to present the prime sentence in one of the participant's languages, and then to ask the participant to produce (or process) a target sentence in another language. If a priming effect is found in such a scenario (i.e. if the syntactic structure of the prime sentence has an influence on the production/processing of the target sentence), this can be considered evidence that bilinguals use, at least to some extent, the same representations and mechanisms for the different languages they speak.

Cross-linguistic syntactic priming: results

One of the first studies using syntactic priming in this way was Loebell & Bock (2003). In their study, German/English bilinguals repeated prime sentences in one of their languages, and subsequently had to describe a picture in the other language. One subset of prime sentences contained either a double-object dative (3a) or a prepositional-object dative (3b), the other subset contained either active (4a) or passive (4b) sentences.

(3a) The girl bought the blind woman a newspaper.

Das Mädchen kaufte der blinden Frau eine Zeitung.

(3b) The girl bought a newspaper for the blind woman.

Das Mädchen kaufte eine Zeitung für die blinde Frau.

(4a) The engine turned the wheel slowly.

Der Motor drehte das Rad langsam.

(4b) The wheel was turned slowly by the engine.

Das Rad wurde langsam von dem Motor gedreht.

After having produced the prime, participants saw a target picture that could either be described by using the same syntactic structure as in the prime, or by using another syntactic structure. If representations or mechanisms of syntactic processing are at least to a certain extent shared between the different languages a person can speak, then a priming effect should be observed here; i.e. the chance to use a particular syntactic structure should be increased when the participant has produced the same syntactic structure in the prime sentence just before.

Loebell & Bock found such a priming effect for dative structures:

After having produced sentences such as (3a), participants were significantly more likely to use a double-object structure when describing the target picture than after having produced (3b). For active vs. passive primes, however, no priming effect was observed. Loebell & Bock argue that memory representations of syntactic structures are shared between the different languages a person can speak, but only as long as the corresponding syntactic structures are similar enough. Dative structures are very similar in English and German, with the same word order being used in both languages. For passive structures, however, the word order differs: German, unlike English, is verb-final when it comes to passive structures, so it is possible that the passive structure is not shared between languages, but represented separately.

In a similar experiment, Hartsuiker, Pickering, & Veltkamp (2004) investigated syntactic priming of active vs. passive structures in Spanish/English bilinguals. In a confederate-priming scenario, a confederate described a picture to a naïve participant, using either an active or a passive syntactic structure. Subsequently, the participant had to describe a picture himself. The authors found that participants produced significantly more passives after being primed by a passive sentence. In this respect, results differ from the Loebell & Bock study described above, in which no priming effect was found for active vs. passive sentences. However, the word order of passive structures in Spanish is the same as in English. As a result, it is possible that the memory representation for passive structures is shared between English and Spanish, because the word order of the structure is identical in both languages, but not between English and German, because here each language requires a different word order to express a passive.

A study by Schoonbaert, Hartsuiker, and Pickering (2006) investigated in how far cross linguistic priming occurs in both directions, and also tested in how far a cross-linguistic syntactic priming effect can be enhanced when the verbs used in prime and target are direct translation equivalents. In an experiment using the same confederate-priming paradigm as in the previous study, native speakers of Dutch with a high proficiency in English were primed with a Dutch sentence which contained either a prepositional-object or a double-object, and subsequently had to describe a picture in English. The verb used in the prime sentence and the verb required to describe the target picture were either direct translation equivalents, or semantically unrelated. Results show a cross-linguistic syntactic priming effect, with participants

being more likely to use a double-object to describe the target picture if the prime sentence also contained a double object. This effect was enhanced when the verb required to describe the target picture was a direct translation equivalent of the verb used in the prime sentence. In a second experiment, the authors reversed the languages used in prime and target: Participants were primed by an L2 sentence, and subsequently had to produce an L1 sentence to describe a picture. Again, the authors observed a cross-linguistic syntactic priming effect: In the L1 target sentence, participants tended to use the same syntactic structure they had previously encountered in the L2 prime sentence. This time, however, the effect was unaffected by whether the verbs in the prime and target sentences were direct translation equivalents or not. While this asymmetric pattern of results regarding a possible effect of translation equivalents raises questions about the interaction between L2 lexical and L2 syntactic representations, the study convincingly demonstrates that cross-linguistic priming occurs both from the L1 to the L2 and from the L2 to the L1.

Further support for the idea that memory representations of syntactic structures are, at least sometimes, shared between languages comes from a study by Desmet & Declerq (2006). Arguing that the priming of dative or active/passive structures in the studies described above could theoretically be explained in terms of lexical effects, they decided to investigate a possible priming effect in a case where syntactic information is not directly linked to lexical entries. In the crucial experiment¹, Dutch/English bilinguals had to

¹ Desmet & Declerq (2006) also includes two control experiments, one showing that a priming effect occurs within the L1 Dutch (i.e. native speakers of Dutch showing a priming effect from Dutch prime sentences to Dutch target sentences), the other excluding the possibility that the cross-linguistic priming effect is based on discourse representations.

complete Dutch prime sentences such as (5a), and English target sentences such as (5b):

- (5a) Gabriel bekrabbelde de cover van het tijdschrift (die/dat/toen)... .
 [Gabriel scratched on the cover of the magazine (that/that/when)... .]
- (5b) The farmer fed the calves of the cow that... .

After the relative pronouns *die* and *dat*, prime sentence (5a) has to be completed by a relative clause. The relative pronoun *die* or *dat* determines which constituent this relative clause can refer to. After *die*, the only grammatical way to complete the sentence is to produce a relative clause which refers to *de cover* (high attachment); while after *dat*, the relative clause has to refer to *het tijdschrift* (low attachment). In the English target sentence, however, participants can still decide whether they attach the relative clause to *the calves* (high attachment) or to *the cow* (low attachment). In short, participants first produce a Dutch prime sentence, which contains either a high- or low-attached relative clause, and then have to complete an English target sentence, for which they can choose whether they attach the relative clause high or low. If the memory representations for these types of relative clauses are shared between the L1 and L2, this should result in a priming effect. The authors found that participants were indeed significantly more likely to produce a high-attached English relative clause after high-attached Dutch primes, relative to low-attached Dutch primes. Indeed, the size of the cross-linguistic priming effect was not smaller than in a within-language control experiment, in which both primes and targets were in Dutch.

A particular problem with the cross-linguistic priming paradigm is that most studies automatically involve code-switching situations. In the studies described above, participants processed an L1 prime sentence, then an L2 target sentence, so code-switching was always present. Thus, it is impossible to decide whether the effects only occur in code-switching situations, or whether they are a general aspect of L2 processing. An attempt to avoid this problem is a syntactic-priming study by Nitschke, Kidd, and Serratrice (2009). In this study, the authors compared how L1 English/L2 German readers, L1 English/L2 Italian readers, native speakers of German, and native speakers of English processed syntactically ambiguous sentences such as the German sentence (6a) or the Italian sentence (6b):

(6a) Hier ist die Frau, die das Mädchen küsst.

[Here is the woman (Subj./Obj.) that the girl (Obj./Subj.) kisses]

(6b) Ecco la donna che bacia la ragazza.

[Here is the woman (Subj./Obj.) that kisses the girl (Obj./Subj.)]

Both the German sentence (6a) and the Italian sentence (6b) are syntactically ambiguous in the sense that it is not clear whether *the woman* is the subject or the object of the sentence. In other words, the subject role can either be assigned to the first noun phrase *the woman*, or to the second noun phrase *the girl*. While both the German and the Italian sentence are globally ambiguous in this respect, native speakers of German and Italian typically prefer to assign the subject role to the first noun phrase. The key question is how native speakers of English, who have learned either German or Italian as an L2,

process such ambiguities. In the English equivalent of the Italian sentence (6b), the subject role can only be assigned to the first noun phrase *the woman*. Thus, the preferred solution in the Italian sentence matches the only possible solution in the English translation equivalent. This is different for the German sentence (6a): In the English translation equivalent of (6a), the subject role can only be assigned to the second noun phrase *the girl*, but native speakers of German reading the German version of the sentence prefer to assign the subject role to *the woman*. If syntactic properties of the L1 have an influence on L2 processing, native speakers of English reading the German sentence (6a) should prefer object-reading, i.e. they should prefer to assign the subject role not to the first noun phrase *die Frau*, but to the second noun phrase *das Mädchen*, because this is the only solution permitted in the English translation equivalent. Native speakers of English reading the Italian sentence (6b), however, should prefer to assign the subject role to the first noun phrase *la donna*, because the English translation equivalent does not allow the subject role to be attached to the second noun phrase. To investigate this, the authors used a picture selection task: The prime trial consisted of an Italian or German prime sentence, followed by two pictures: One picture showed the event previously described in the prime sentence, and favoured the object-reading interpretation; the other picture showed an unrelated event. Participants were instructed to select the picture showing the event described in the last sentence they had read just before. Thus, the fact that the picture favoured an object-reading interpretation was supposed to prime object-reading. The target trial consisted of a second syntactically ambiguous German or Italian sentence, which was again followed by two pictures: This

time, both pictures showed the event described in the target sentence; while one picture favoured object-reading, the other one favoured subject-reading. Once again, participants were asked to choose the picture which showed the event described in the previous sentence. The authors found that L1 English/L2 German readers chose object-reading pictures significantly more often than all three other groups (L1 English/L2 Italian readers, native German readers, native Italian readers). They interpreted this finding as an effect of L1 influence, arguing that the effect occurred because the English translation equivalent of the German sentence, the subject role can only be assigned to the second noun phrase. According to the authors, this syntactic property of the L1 biased L1 English/L2 German readers towards interpreting the first noun as an object, and ultimately caused them to favour significantly more pictures consistent with the object-reading interpretation.

In sum, cross-linguistic syntactic priming convincingly demonstrates that the L1 and L2 are not represented totally separately within the syntactic-processing system. In all studies described above, the production of an L2 sentence was influenced by an L1 sentence participants had read shortly before. However, a number of limitations of this research method deserve to be mentioned as well: First, most studies described above ask the participant to not only process, but also to produce the prime, the target, or both. As a result, it is impossible to decide whether the effects occur during sentence comprehension, or whether they only occur during sentence production. Second, while cross-linguistic priming results allow us to draw conclusions about the representation of L2 syntactic structures in memory, it is difficult to

draw conclusions about mechanisms of L2 processing. While syntactic structures from the L1 and L2 might share a single entry in memory, it is theoretically possible that the mechanisms of on-line syntactic processing are still separate for the L1 and L2. In metaphorical terms, syntactic information from the L1 and the L2 might be stored together in the same library, but there are still separate librarians responsible for each of the two languages. Both the L1 librarian and the L2 librarian might then work in the same library, where they get the information necessary to do their work, but without ever talking to each other directly. In this respect, while cross-linguistic syntactic priming allows us to investigate whether properties of the L1 have an influence on how L2 structures are stored in memory, it does not allow us to investigate whether the L1 has an influence on L2 syntactic processing.

An alternative approach, which makes it possible to investigate L2 syntactic processing on-line, involves making systematic use of cross-linguistic differences in processing strategies. Such studies are reviewed in the following chapter.

CHAPTER 4

Syntactic Processing in a Foreign Language

Temporarily ambiguous sentences

One of the first on-line experimental studies investigating syntactic L2 processing was conducted by Frenck-Mestre and Pynte (1997). Their two experiments represent a good example of why temporarily ambiguous sentences can be useful to investigate L2 syntactic processing. In their first experiment, English/French bilinguals and a control group of French monolinguals read structurally ambiguous sentences while their eye movements were recorded. The authors showed their participants temporarily ambiguous French structures such as (7a-b) and (8a-b), a type of structural ambiguity that exists in both English and French:

(7a) Il accuse son chef de meurtre mais il ne peut pas fournir de preuve.

(7b) Il accuse son chef de service mais il ne peut pas fournir de preuve.

(8a) Ils regardent la vendeuse de travers puis ils quittent le magasin.

(8b) Ils regardent la vendeuse de robes puis ils quittent le magasin.

The syntactic structure of these sentences is temporarily ambiguous: When the processor reaches *de* in sentence (7a), it is not clear whether the upcoming noun phrase (*meurtre*, *service*) should be attached to the verb phrase *accuse* or to the noun phrase *son chef*. Sentences (8a) and (8b) follow the same logic: At *de*, it is unclear whether the upcoming noun phrase should be attached to the verb phrase *regardent*, or to the noun phrase *la vendeuse*. In sentence (8a), this ambiguity is resolved in favour of verb-phrase attachment, while in sentence (8b), it is resolved in favour of noun-phrase attachment.

Frenck-Mestre and Pynte were interested in whether L2 readers deal with such local ambiguities differently than native speakers, but also investigated which types of information readers are able to make use of while trying to deal with the ambiguity: In the above sentences, it is possible to use lexico-syntactic information carried by the French verbs *accuser* and *regarder* to resolve the ambiguity: Sentence (7a) contains a verb which is normally used ditransitively (*accuser*). If L2 readers are able to use this type of lexico-syntactic information, this should lead to the processor expecting another verb-phrase constituent in sentence (7a). This would bias the analysis towards verb-phrase attachment. Sentences (8a) and (8b), however, contain a monotransitive verb (*regarder*), so lexico-syntactic information carried by the verb does not create a bias towards either noun-phrase- or verb-phrase-attachment. If L2 readers are able to use lexico-syntactic information from the verb to resolve the ambiguity, this should result in sentence (7a) being easier to process than (7b), with no (or less of a) difference between sentences (8a) and (8b).

Results showed that for both native readers and L2 readers, ambiguity resolution was affected by verb type (monotransitive vs. ditransitive), indicating that L2 readers, just like native readers, are able to make use of lexico-syntactic information to resolve the ambiguity. However, Frenck-Mestre and Pynte also found at least some evidence for differences between native and L2 processing: For L2 readers, but not for native readers, the number of regressions from the area comprising the point of disambiguation and the two following segments (e.g. *meutre mais il* in sentences (7a) and (7b)) was larger in VP-sentences than in NP-sentences. Also, if the verb was

monotransitive, L2 speakers, but not native speakers, showed longer first-pass gaze durations in VP-sentences at the point of disambiguation (e.g. *meurtre, service*). All this suggests that L2 readers, unlike native readers, generally experienced more difficulty in sentences requiring verb-phrase (VP) attachment, such as (7a) and (8a), relative to sentences requiring noun-phrase (NP) attachment, such as (7b) and (8b); The authors interpret this as evidence for a general low-attachment preference in L2 readers: To save processing resources, L2 readers may prefer to attach a new constituent to the most recently processed constituent, and thus prefer low attachment. As a result, they may experience difficulty when the ambiguity is resolved in favour of high attachment.

Frenck-Mestre & Pynte's second experiment also investigates the processing of a temporarily ambiguous structure, but used sentences which were ambiguous in only one of the L2 readers' languages. This makes it possible to investigate a possible influence of the L1 on processes of ambiguity resolution. French/English and English/French bilinguals read English sentences such as (9a) and (9b), as well as their French translation equivalents:

(9a) Every time the dog obeyed the pretty little girl showed her approval.

(9b) Every time the dog barked the pretty little girl showed her approval.

Sentence (9a) is temporarily ambiguous in English; *the pretty little girl* can initially be analyzed as a direct object of *obeyed* (as in *The dog obeyed the little girl*), but is in reality the subject of the upcoming main clause. Sentence

(9b), however, is not temporarily ambiguous, because the verb *bark* is obligatorily intransitive. The reason why this particular structure is interesting for research on L2 processing is that the French translation equivalents of (9a) and (9b) are both unambiguous, because the French translation equivalents of *obeyed* and *barked* are both obligatorily intransitive. Consequently, if a native speaker of French activates lexico-syntactic information from his L1 while reading an English sentence such as (1a), this would help him to avoid being garden-pathed.

The authors found that for native speakers of French reading English sentences, first-pass reading times at the subordinate verb were longer for verbs such as *obeyed* than for verbs such as *barked*. For native English readers, however, reading times between these two verb types did not differ. Frenck-Mestre & Pynte interpret this as an effect of L1 influence: The fact that the L1 translation equivalent of the verb *obeyed* uses a different kind of sub-categorization frame causes difficulty for the L2 reader. The effect, however, only occurred in the verb segment; there were no effects in later segments of the sentence. In other words, the effect of L1 influence was rapidly overcome: The difference between *bark* and *obey* was only present at the verb itself, but not in any later segments of the sentence. Thus, the authors argue that the L1 influence effect was very short-lived, and did not influence the resolution of the garden-path structure.

Frenck-Mestre & Pynte's study can be considered important for a number of reasons: First, it is one of the first studies investigating specifically syntactic effects in L2 processing. Second, the study used an on-line method, eye-tracking, while most previous studies had used off-line methods such as

questionnaires or error analyses. The use of an on-line method made it possible to investigate the time course of processing. Third, the experiments demonstrated how valuable the use of ambiguous structures can be for research on L2 processing. The resolution of a temporary ambiguity involves the decision between two possible syntactic structures; by experimentally manipulating information that might potentially affect the resolution of the ambiguity (such as lexico-syntactic information in Experiment 1, or L1 subcategorization frames in Experiment 2), we can investigate what kinds of information L2 speakers can make use during syntactic processing. Finally, the experiments address two important possible reasons why L2 syntactic processing might differ from L1 processing: Experiment 1 suggests that L2 readers might have to save processing resources, and might thus use parsing strategies that allow them to do so, while Experiment 2 suggests that L2 parsing might be influenced by properties of the L1.

Frenck-Mestre and Pynte's conclusions were discussed controversially in subsequent papers: Especially the claim that L2 readers' processing is influenced by properties of the L1 received a lot of criticism. For example, Papadopoulou & Clahsen (2003) point out that the difference in gaze durations between verbs such as *obey* and verbs such as *bark* in Experiment 2 could have been caused by factors other than L1 influence: Optionally transitive verbs such as *obey* might generally be harder to process for L2 readers than obligatorily intransitive verbs such as *bark*, simply because their subcategorization frame is more complex. Furthermore, Frenck-Mestre and Pynte's studies did not include a control group of native speakers of an L1 in which verbs such as *bark* and *obey* have the same subcategorization frames as

in the target language. Without such a control group, it is difficult to determine whether the effect is caused by L1 influence, or whether it reflects general processing difficulties that *all* native speakers experience, regardless of which L1 background they come from.

As already mentioned above, Frenck-Mestre & Pynte's studies can be considered the start of a line of research investigating ambiguity resolution in L2 readers. Most studies within this line of research have focussed on a type of relative-clause-attachment ambiguities such as the one shown in example (10), quoted from Papadopoulou & Clahsen (2003):

(10) A man looked at the teacher of the pupil who was in the schoolyard.

The above sentence is globally ambiguous because the relative clause *who was in the graveyard* can either be attached to the noun phrase *the teacher* (commonly referred to as *high* attachment) or to the noun phrase *the pupil* (*low* attachment). This type of ambiguity exists in a large number of languages, such as English, German, Greek, Spanish, or Russian. Interestingly, however, languages differ regarding whether they prefer high or low attachment. A number of classical monolingual studies have demonstrated that native speakers of English reading English sentences usually favour low attachment in these cases (e.g. Frazier, 1978; Frazier & Clifton, 1996; Carreiras & Clifton, 1999), and this was originally thought of as a universal parsing strategy called *late closure*, which allows readers to reduce processing costs by attaching a constituent to the phrase they currently

process. Indeed, some languages, such as Swedish, Norwegian, Romanian (Ehrlich, Fernandez, Fodor, Stenshoel & Vinereanu, 1999), or Arabic (Abdelghany and Fodor, 1999), share this preference for low attachment. Subsequently, however, it was shown that a number of other languages, such as Dutch (Brysbaert & Mitchell, 1996), French (Zagar, Pynte & Rativeau, 1997), Spanish (Cuetos & Mitchell, 1998), and German (Hemforth, Konieczny, Scheepers & Strube, 1998), generally favour high attachment.

In short, while the ambiguity in sentence (10) exists in many languages, the way it is typically resolved differs across languages. The crucial question is how L2 speakers typically resolve the ambiguity. Will they use the preference from the L2, or will they transfer the preference from their L1?

Studies investigating this question have lead to mixed results. In an eye-movement study, Frenck-Mestre (1997) investigated how native speakers of French, English and Spanish process French sentences such as (11a) and (11b) below:

(11a) Jean connaît la gouvernante des filles qui arrivent de Paris...

(= Jean knows the housekeeper (singular) of the girls (plural) who arrive (plural) in Paris...)

(11b) Jean connaît les filles de la gouvernante qui arrivent de Paris...

(= Jean knows the girls (plural) of the housekeeper (singular) who arrive (plural) in Paris...)

The syntactic structure of these French sentences resembles the structure in sentence (10). However, unlike English, French allows for a disambiguation through the use of gender marking. As a result, the sentence is not globally, but only temporarily ambiguous. The ambiguity occurs at *qui*. At this point, it is not yet clear whether the upcoming relative clause should be attached to *gouvernante* (high attachment) or to *filles* (low attachment). The disambiguation occurs at the subordinate verb *arrivent*; this subordinate verb is marked as plural, so the subordinate clause can only be attached to a plural noun. In (11a), the ambiguity is thus resolved in favour of attaching the relative clause to the second noun phrase (low attachment), while in (11b), it is resolved in favour of attaching it to the first noun phrase (high attachment).

As already mentioned, such ambiguities exist in a number of languages, but languages differ in terms of how such syntactic ambiguities are typically resolved: French native speakers typically prefer high attachment, and experience temporary difficulty when the ambiguity is resolved in favour of low attachment. This is also the case for Spanish, but English typically favours low attachment. Again, the question is whether the way an L2 speaker of French processes this ambiguity will be influenced to some extent by the way such ambiguities are typically resolved in the L1.

Frenck-Mestre found that for native speakers of Spanish, gaze durations at the subordinate verb (*arrivent*) were significantly longer for sentences such as (11a) than for sentences such as (11b), indicating that Spanish readers experienced more difficulty when the ambiguity was resolved in favour of low attachment. Native speakers of English, however, showed no significant difference in gaze durations at the subordinate verb; actually

results show a non-significant trend in the opposite direction, with gaze durations at the subordinate verb being longer for sentences such as (11b) than for (11a). Frenck-Mestre argues that the two non-native groups were influenced by properties of their respective L1s: For the native speakers of Spanish, both the L1 and the L2 prefer high attachment, so it makes sense that this group finds L2 sentences which are resolved in favour of high attachment easier than sentences which are resolved in favour of low attachment. For the English readers, however, the L2 favours high attachment, while the L1 favours low attachment. As a result, this group does not show a significant preference for either high or low attachment when reading the French sentences.

In a further study, Frenck-Mestre (2002) addressed the question whether an effect of L1 influence such as the one observed in the experiment described above is a permanent property of L2 processing, or whether L1 influence disappears once a bilingual has become highly proficient in the L2. To investigate this, Frenck-Mestre replicated the above experiment, this time with a sample of native speakers of English with a high proficiency in French. Unlike the group of less proficient native speakers of Spanish tested in the previous experiment, the more proficient group showed a native-like data pattern, with gaze durations at the subordinate verb being longer when the sentence was disambiguated in favour of low attachment. Frenck-Mestre concluded that parsing preferences can change as a result of increasing proficiency, with less proficient L2 speakers being affected by properties of their L1, and more proficient L2 speakers gradually becoming more native-like in the way they resolve relative-clause-attachment ambiguities.

Another study proposing that properties of the L1 can, at least in principle, have an influence on the resolution of RC-attachment ambiguities is Dussias (2003). The study investigated how L1 English- L2 Spanish bilinguals and L1 Spanish- L2 English bilinguals process Spanish or English versions of sentences containing a relative-clause attachment ambiguity of the same type as in sentence (10) above. As already mentioned, English is a language which generally favours low attachment, while Spanish favours high attachment. The crucial question is how L2 learners resolve this type of ambiguity when reading such sentences in their L2: Do they favour the same type of ambiguity resolution generally favoured in the particular L2, or does the preference from their L1 influence the way they resolve the ambiguity?

In Dussias' first study, structurally ambiguous sentences such as (12) were presented in a questionnaire, followed by a question, asking which constituent the relative clause should be attached to:

(12) Peter fell in love with the daughter of the psychologist who studied in California.

Who studied in California?

- a. The daughter studied in California.
- b. The psychologist studied in California.

While for the English questionnaire, differences between the groups were too small to be interpretable, results for the Spanish version showed a clearer pattern: While the control group of Spanish monolinguals showed a clear

preference to attach the relative clause high (i.e. to choose answer (a.) in the above example), both the L1 English-L2 Spanish and the L1 Spanish- L2 English bilinguals showed significantly less of a preference for high attachment. As one possible explanation to account for this data pattern, Dussias suggested that a reader's attachment preference might be influenced by other languages a reader can speak. To test this possibility further, Dussias also conducted a self-paced reading experiment in Spanish, in which the ambiguity was resolved in favour of either high or low attachment by gender marking, as in the sentences below:

(13a) El perro mordio´ al cunado de la maestra que vivio´ en Chile con su esposo.

(= The dog bit the brother-in-law of the teacher(feminine) who lived in Chile with his/her ²husband.)

(13b) El perro mordio´ a la cunada del maestro que vivio´ en Chile con su esposo.

(= The dog bit the sister-in-law of the teacher(masculine) who lived in Chile with his/her husband.)

(13c) El perro mordio´ a la cunada de la maestra que vivio´ en Chile con su esposo.

(= The dog bit the sister-in-law of the teacher(feminine) who lived in Chile with his/her husband.)

(13d) El perro mordio´ a la maestra que vivio´ en Chile con su esposo.

² Please note that in Spanish, the pronoun *su* is gender-neutral; it is used for both feminine and masculine constituents, and does not give information about the gender of the noun following it.

(= The dog bit the teacher (feminine) who lived in Chile with his/her husband.)

In all four sentences, the final phrase *with his/her husband* requires the relative clause to be attached to a feminine constituent. In sentence (13a), this resolves the ambiguity in favour of low attachment: Attaching the relative clause to *brother-in-law* is impossible here because *brother-in-law* is not feminine, so the relative clause can only be attached to *the teacher*. Sentence (13b) is disambiguated in favour of high attachment: Again, the relative clause can only be attached to a feminine constituent, but *teacher* is masculine, so the only other possibility is to attach it to *sister-in-law*. Sentence (13c) is globally ambiguous (both *sister-in-law* and *teacher* are feminine here, so the relative clause can be attached to either of them), and (13d) is an unambiguous control sentence. Dussias used reading times at the point of disambiguation (*with his/her husband*) as a measure of difficulty. Results show that Spanish monolinguals find sentence (13a) harder than (13b), consistent with the idea that Spanish favours high attachment. For both L1 English – L2 Spanish and L1 Spanish – L2 English bilinguals, however, the data pattern was reversed: For both groups, reading times at the point of disambiguation were longer for (13b) than for (13a)³. According to Dussias, a possible explanation for this data pattern is that readers were influenced by properties of other languages that they can speak. Given that the group of L1 Spanish – L2 English bilinguals was living in an English-speaking

³ Note that the difference was only statistically significant for the group of L1 Spanish-L2 English bilinguals though.

environment, it is possible that even L2 attachment preferences might have influenced L1 processing.

While most studies investigating relative-clause attachment preferences in L2 speakers have focussed on a possible influence of the L1 on L2 processing, perhaps more surprising are studies looking at whether extensive exposure to an L2 can change the way L2 readers resolve this type of ambiguity when reading in their L1.

In an eye-tracking experiment in Spanish, Dussias & Sagarra (2007) investigated how (a) Spanish monolinguals, (b) L1 Spanish speakers with a limited amount of exposure to L2 English, and (c) L1 Spanish speakers who had been living in an English-speaking country for an extended time processed syntactically ambiguous Spanish sentences such as (8a) and (8b):

(14a) El policía arrestó a la hermana del criado que estaba enferma desde hacía tiempo.

(= The police arrested the sister of the servant(masculine) who had been ill (feminine) for a while.)

(14b) El policía arrestó al hermano de la niñera que estaba enferma desde hacía tiempo.

(= The police arrested the brother of the baby-sitter(feminine) who had been ill (feminine) for a while.)

Both example sentences are morphologically disambiguated towards either high (as in 14a) or low (as in 14b) attachment: In both (14a) and (14b), the

adjective *ill* can only refer to a feminine constituent; in sentence (14a) this forces high attachment because *sister* is feminine, while *servant* is not. In sentence (14b), only *baby-sitter* is feminine, so low attachment is the only option here.

As already mentioned, Spanish is a language which generally favours high attachment. As all 3 groups of participants consist of L1 Spanish speakers, and as all sentences were Spanish as well, all 3 groups should find sentence (14b) harder than (14a), because sentence (14a) resolves the ambiguity in a way which is preferred by the language, while (14b) resolves the ambiguity in the non-preferred way. However, the authors found that while Spanish monolinguals and Spanish L1 speakers with limited exposure to English indeed favoured high attachment, the group of Spanish L1 speakers with extended exposure to English actually preferred low attachment (as indicated by total reading times at the disambiguating word). Thus, Dussias & Sagarra argue that properties of English can influence the way readers process sentences from their native language.

The claim that extensive exposure to a second language can influence native-language syntactic processing is also supported by a study by Blattner (2007). Using the self-paced-reading paradigm, Blattner investigated how native speakers of English and highly proficient L1 French/L2 English speakers, process temporarily ambiguous structures such as (15a) and (15b):

(15a) When the naïve explorer lands the damaged helicopter stops in a chaotic manner.

- (15b) When the naïve explorer panics the damaged helicopter stops in a chaotic manner.

In English, the verb *lands* is optionally transitive; it can be followed by a direct object, but does not require one. When reading a sentence such as (15a), the fact that *lands* is optionally transitive can cause processing difficulty: A parser could incorrectly assume that *the damaged helicopter* is the direct object of the verb *lands*. This would cause difficulty when the parser gets to the verb *stops*, where it becomes clear that *the damaged helicopter* is actually not a direct object, but the subject of the upcoming main clause.

The French translation equivalent of *lands*, however, is obligatorily intransitive. As a result, while a sentence such as (15a) is temporarily ambiguous in English, its French translation equivalent is unambiguous. Blattner asked native speakers of English and native speakers of French with a highly advanced proficiency in English to read these English sentences. Results show that for both groups, reading time measures at *stops* were longer for sentence (15a) than for (15b), indicating that both groups experienced difficulty because they initially considered *the damaged helicopter* to be the direct object of *lands*. As a second step, Blattner then showed the group of native French speakers French translation equivalents of the English stimuli, and compared the reading times with those from a group of monolingual native speakers of French without advanced proficiency in English. He found that the monolingual French group did not experience any difficulty at the disambiguating segment. The advanced L1 French/L2 English speakers,

however, again experienced difficulty at the disambiguating segment, even for the French translation equivalents of (15a). Blattner argues that extensive exposure to English changed the way these L1 French/L2 English speakers processed sentences in the L1, and caused them to activate the incorrect transitive analysis even though in the L1 translation equivalent of sentence (15a).

While the last two studies just described do not investigate L1 effects in L2 processing, but actually L2 effects in L1 processing, both studies describe cases where properties of one language can influence processing of another language. Both studies present evidence that a parser is in principle sensitive to similarities between syntactic structures from the L1 and the L2, and can make use of information acquired during L2 processing even when processing an L1 sentence. In this respect, the studies show that a central prerequisite for L1 effects in L2 processing is fulfilled.

While the studies described above suggest that the L1 can, at least in principle, have some sort of influence on syntactic processing in the L2, other studies have come to different conclusions. In a self-paced-reading study on Greek, Papadopoulou & Clahsen (2003) showed Greek sentences such as (16a) and (16b) to a group of learners of Greek:

(16a) Enas kirios fonakse ton fititi tis kathighitrias pu itan apoghoitevmenos apo to
neo ekpedheftiko sistima.

(= A man called the student (masculine) of the teacher (feminine) who was disappointed (masculine) by the new educational system.)

(16b) Enas kirios fonakse ton fititi tis kathighitrias pu itan apoghoitevmeni apo to neo ekpedheftiko sistima.

(= A man called the student (masculine) of the teacher (feminine) who was disappointed (feminine) by the new educational system.)

While in English, the structure of sentences such as (16a) or (16b) is globally ambiguous, Greek allows for a disambiguation through the use of gender marking. In sentence (16a), the ambiguity is resolved in favour of high attachment: The gender marking at *disappointed* in sentence (16a) does not match the gender of *the teacher*, so the relative clause can only be attached to *the student*. In sentence (16b) this is the other way round, so the ambiguity is resolved in favour of low attachment.

As participants, the authors recruited L2 learners of Greek, whose native languages (German, Russian, and Spanish) all favoured high attachment. In a control study with native speakers of Greek, the authors showed that Greek, just like the native languages of the learners, favours high attachment. Thus, if learners transferred attachment preferences from their native language while processing Greek sentences, this should lead to a preference for high attachment, especially given that Greek itself also possesses a preference for high attachment. As a result, they should find sentence (16a), where the disambiguation matches their L1 preference, easier than (16b).

The participants, however, did not show any preference for either high or low attachment. In this respect, they differed significantly from the control group of Greek L1 readers, who indeed showed a significant preference for high attachment. On the basis of this result, Papadopoulou and Clahsen concluded that while there are qualitative differences between L1 and L2 parsing, these differences are not the result of L1 influence.

A number of important methodological problems regarding the above study deserve to be mentioned, however: First, the conclusion that the L1 does not play a role in the resolution of the relative-clause-attachment ambiguity is mainly based on a null effect, a lack of a difference between condition (16a) and (16b) for the group of L2 speakers. It is possible that this null effect is simply a result of a lack of statistical power. The fact that the sample of L2 speakers was very diverse supports this possibility to some extent: The L2 speakers came from 3 different language backgrounds and had very different L2 proficiency levels. This might have added error variance to the data, thus reducing statistical power. Second, the study did not test whether participants really had a preference for high attachment for the specific L1 translation equivalents of the Greek items. While the native languages of the participants in principle had a high attachment preference, it is not clear whether that is actually true for the specific sentences used in the experiment.

As a result, it is somewhat debatable whether the results obtained by Papadopoulou & Clahsen (2003) can be considered evidence against L1 influence in L2 syntactic processing. The fact that the study still found differences between the L1 and L2 groups is, however, interesting for another

reason: The study found processing differences between the L1 and L2 groups which cannot be explained by effects of L1 influence. This suggests that there may be qualitative differences between native and non-native syntactic processing which originate from sources other than L1 influence.

Ambiguity resolution in L2 speakers: conclusions and problems

The studies on ambiguity resolution described in this chapter have opened up new possibilities to study L2 processing. On-line measures of behaviour in the face of a structural ambiguity can be considered a more sensitive measure than traditional work on typical errors in L2 processing: The fact that an L2 learner does not make a mistake when reading a particular L2 sentence does not automatically imply that he does not experience any difficulty; instead, it could simply be that while the sentence is difficult, but he manages to overcome this difficulty. The study of temporarily ambiguous structures, however, allows for a direct on-line measure of difficulty (e.g. through self-paced reading or eye-tracking) at specific segments of the sentence.

Before I move on, a particular theoretical problem associated with the use of relative-clause-attachment ambiguities deserves to be mentioned here: To prove the existence (or non-existence) of an influence of the L1 in L2 syntactic processing by investigating processing of relative-clause-attachment ambiguities, it is necessary to assume that it is actually the level of syntactic processing, and not another level of sentence processing, at which attachment

preferences come into play. While the decision to attach a relative clause high or low is a syntactic decision, a preference to choose high attachment over low attachment might actually invoke its influence not during syntactic analysis, but on another level of language processing. Within the monolingual research on attachment preferences, it is not at all clear on which level of processing an attachment preference comes into play. According to Frazier & Clifton's (1996) construal account, whether the processor has a preference for high or low attachment depends on what other constructions are possible within the specific language. Several languages possess an alternative structure, which avoids the ambiguity. An example is given in sentences (17a) and (17b):

(17a) A man looked at the teacher of the pupil who was in the schoolyard.

(17b) A man looked at the pupil's teacher who was in the schoolyard.

Sentence (17a) is a typical relative-clause-attachment ambiguity. English, however, possesses an alternative structure, shown in sentence (17b), which avoids precisely that ambiguity. Frazier & Clifton (1996) argue that the availability of this alternative structure influences whether the processor prefers high or low attachment: If a speaker intends to express that the teacher was in the graveyard, he does not have to use an ambiguous structure, but has the possibility to use the alternative structure shown in (17b), thus avoiding the ambiguity. If the speaker produces the ambiguous structure (17a) instead, it is reasonable to assume that he intends to express that the pupil, and not the teacher, was in the graveyard. Thus, the construal account assumes that

attachment preferences actually come into play at the pragmatic/discourse level of processing, rather than at the level of syntactic processing. In this respect, it is unclear in how far the effects found in the studies mentioned above really reflect aspects of L2 syntactic processing.

Cross-linguistic differences in unambiguous sentences

While the majority of on-line processing studies investigating L1 influence have relied on temporarily ambiguous structures, this is not the case for all studies. A study attempting to systematically use cross-linguistic differences to gain insight into L2 syntactic processing without relying on temporarily ambiguous structures is Juffs (1998). In a moving-window experiment, Juffs compared how native speakers English and native speakers of particular Romance and Asian languages processed causative English sentences, such as (18a), and inchoative English sentences, such as (18b).

(18a) Sally broke the window.

(18b) The window broke.

These particular structures are interesting because of particular features they possess in the native languages of the two participant groups: In Romance languages, the inchoative structure requires an additional morpheme (*se*), while the structure of causative sentences resembles the English structure. If properties of the L1 influence L2 processing, native speakers of Romance languages should thus find causative sentences (a structure which is similar in

their L1) easier to process than inchoative sentences (a structure which works differently in their L1). In Asian languages, however, it is the causative structure which requires additional morphological marking, while the inchoative structure closely resembles the English inchoative structure. If properties of the L1 have an influence on L2 processing, native speakers of these particular Asian languages, unlike the Romance group, should find inchoative English sentences easier than causative ones. While results were difficult to interpret, presumably because of large variation in English proficiency, reading time patterns for both non-native groups differed significantly from the control sample of native speakers. Juffs thus argues that parsing mechanisms of non-natives might differ from native parsing mechanisms.

Another approach, which also tries to make use of similarities between different languages, involves the processing of particular syntactic violations, such as violations of grammatical-gender agreement. Sabourin (2003) investigated how L2 speakers of Dutch, with either German, English, or Romance languages as their L1, processed local violations of gender agreement in Dutch sentences. The three different L1 backgrounds are interesting because of the varying degree of similarity between the particular L1 and Dutch regarding grammatical gender: The German grammatical gender system is very similar to the Dutch system. Romance languages possess grammatical gender, but their Gender systems are quite different from the Dutch one. English does not have grammatical gender. If properties of the L1 influence L2 processing, the varying degree of similarity between grammatical gender in Dutch and in the respective L1 should have an

influence on the way the L2 groups process Gender violations in Dutch. In an off-line task in which participants had to attach gender to Dutch words, Sabourin found that native speakers of German performed as well as native Dutch speakers, while the Romance group performed considerably worse, and the English group performed at chance level. In a subsequent ERP experiment, she presented the four groups with Dutch phrases which contained violations of grammatical gender. Native speaker of German, just as the Dutch control sample, displayed a P600 effect, suggesting that they were sensitive to such violations. Native speakers of Romance languages and English, in contrast, did not show a P600 effect. Sabourin argues that participants were influenced by properties of their L1 in the sense that the varying degrees of similarity between the Dutch gender system and the respective L1 gender systems had an effect on performance.

In sum, the studies described in this chapter present a diverse picture of L2 syntactic processing, with some results suggesting that L1 and L2 processing are similar in nature, others claiming that L2 speakers are influenced by properties of their L1, and yet others arguing that there are qualitative differences between L1 and L2 processing which are not based on L1 influence. In this respect, the experiments described in the following chapter are designed as a first step towards an integrated model of L2 syntactic processing, which can account for these different findings.

CHAPTER 5

What influences L1 influence?

As shown in Chapters 1-4, the existence of effects of L1 influence in L2 syntactic processing is highly controversial: One group of studies, including studies on cross-linguistic syntactic priming and studies in the context of the Competition Model, claims that L1 influence exists, and sometimes assumes that L1 influence is a central characteristic of L2 processing. A second group of studies argues against the existence of such L1 influence effects, and argues that L2 processing is essentially very similar to L1 processing. Finally, a third group of studies, such as the studies conducted in the context of the Shallow-Structure Account, claim that while there are qualitative differences between L1 and L2 processing, these differences are not based on effects of L1 influence, but on other unique properties of L2 processing.

The debate over why these studies have led to different results has, at least to a large extent, concentrated on methodological issues, such as whether the measures used in a particular study were sensitive enough, whether a particular effect can really be considered syntactic in nature, or whether an effect really reflects L1 influence, rather than other possible differences between L1 and L2 processing. The current chapter aims to focus on another way of explaining the opposing results, by discussing the possibility that L1 influence effects do not always occur, but only in some specific cases, depending on specific variables. Such variables, which could possibly influence the presence or absence of an L1 influence effect, might include particular traits of the L2 speakers (e.g. L2 proficiency), properties of the specific languages involved (e.g. the degree of similarity between particular L1 and L2 structures), or specific aspects of the situation in which language processing occurs (e.g. the presence or absence of a code-switching situation).

Given that it is still under debate whether effects of L1 influence in L2 syntactic processing exist at all, the discussion about what variables might possibly influence such an effect is still at the very beginning. Only a very small number of studies have explicitly manipulated such variables to investigate whether an effect of L1 influence emerges. Nevertheless, a number of variables which might potentially explain the opposing results have been proposed. In the following, I intend to discuss the possible role of (a) *L2 proficiency*, (b) *working memory span*, (c) *similarity between L1 and L2*, (d) *the presence or absence of a code-switching situation*, and (e) *levels of language processing*.

L1 influence and L2 proficiency

It is quite natural to assume that L1 influence only occurs at specific levels of L2 proficiency. In this context, the most straightforward assumption is that L1 influence is strongest at lower proficiency levels, and gradually declines with increasing L2 proficiency. An example of a data pattern supporting this assumption can be found in the already-mentioned study by Frenck-Mestre (2002), described in Chapter 4 above: In this study on relative-clause attachment preferences in French, Frenck-Mestre found an effect of L1 influence for native speakers of English with a relatively low proficiency in L2 French, but when she replicated the study with a sample of people with a higher L2 proficiency, this effect had disappeared. Instead, the highly proficient L2 group, unlike the low-proficient sample, showed the same attachment preferences as the native French control sample. In other words, while the low-proficient group had relied on information from the L1 (in this case, L1 relative-clause-attachment preferences) to resolve the ambiguity, the high-proficient group had already learned how such

ambiguities are typically resolved in French, and was able to process the sentences without having to rely on L1 information.

Frenck-Mestre (2002) represents a case where L1 influence entirely disappears with higher L2 proficiency. A study by I-Ru Su (2001) shows that in other cases, an L1 influence effect, while declining with higher L2 proficiency, can sometimes remain very robust at high proficiency levels. Native English learners of L2 Chinese and native Chinese learners of L2 English were each divided into three sub-groups based on their proficiency in the respective L2. In a design based on the sentence-interpretation paradigm used in Killborn (1987, 1989, described in Chapter 2), participants were shown English and Chinese strings of L2 words consisting of a subject, a monotransitive verb, and a direct object, such as (19), (20), and (21) below:

- (19) The stone hits the girl.
- (20) Pushes the window the dog.
- (21) The monkey the apple bumps.

Participants had to indicate which of the two nouns they considered to be the agent. Within the strings of words, the author systematically manipulated two types of cues which can be used to identify the agent in a sentence: word order and animacy. E.g. in example string (1), the fact that “stone” is mentioned first would suggest that “stone” is the agent, but the fact that “girl” is animate while “stone” is inanimate would suggest that “stone” is the agent instead. How reliable each of these two cues is differs between languages: Chinese is relatively variable when it comes to word order, so word order is a relatively weak cue

when it comes to the task of identifying the agent, and animacy is normally more reliable. English, in contrast, possesses relatively strict word order rules, so word order is more reliable. However, because in English sentences thematic roles are normally clarified by word order alone, it is not necessary to use other cues, such as animacy, to indicate what the agent is in a sentence. In this respect, animacy can be considered a relatively weak and unreliable cue for identifying the agent, while word order can be considered a relatively stronger and more reliable cue in English, because English is very strict with regard to word order.

In a control study, the author found that native speakers of English reading English strings heavily relied on word order to determine the agent, while native speakers of Chinese reading Chinese strings heavily relied on animacy. If a native speaker of English reading in L2 Chinese is influenced by properties of his L1 English, it is possible that he uses the English preference to rely mainly on word-order not only when reading in L1 English, but also in L2 Chinese. Similarly, a native speaker of Chinese reading English sentences might also use the Chinese preference to rely heavily on animacy when reading in L2 English. By testing three different L2 proficiency groups, from beginning L2 learners to almost native-like proficiency, it is possible to investigate in how far such an effect of L1 influence gradually disappears or persists with higher L2 proficiency. For the results of the English participants, I-Ru Su's results show all three groups, regardless of L2 proficiency heavily relied on word order when trying to determine the agent in Chinese word strings. While the participant groups with a higher proficiency showed a tendency to also make use of animacy to a small extent, even the group with the highest L2 Chinese proficiency (native English speakers with an almost native-like L2 proficiency in Chinese, who had

been living in a Chinese-speaking environment for several years) still relied predominantly on word order. In other words, all English groups experienced strong L1 influence, in the sense that they transferred an English word-order based strategy for thematic-role assignment from their native language to L2 Chinese. Groups with a higher L2 proficiency, at least to some extent, tended to use the more appropriate animacy-based strategy as well, but still relied predominantly on word order. The Chinese groups reading English strings showed a similar kind of L1 influence: Native Chinese speakers with a low proficiency in L2 English tended to rely almost exclusively on animacy when assigning thematic roles to the English strings. Groups with a higher proficiency tended to gradually make use of word order as well, but still relied on animacy to a larger extent than the control group of native English speakers reading English strings. In this respect, results for both the Chinese and the English groups suggest that while L1 influence may decline with higher proficiency, even L2 speakers at a very high proficiency level can still experience a certain degree of L1 influence.

Frenck-Mestre (2002) and I-Ru Su (2001) represent two cases of studies in which L1 influence gradually declined with higher proficiency. While the studies differ regarding the question whether L1 influence is reduced to zero at very high levels of proficiency, or whether even highly proficient L2 speakers can still show effects of L1 influence, both studies suggest a negative linear correlation between L1 influence and proficiency, with L1 influence being strongest at low proficiency levels, and gradually declining with increasing proficiency. This might be an appropriate model for tasks such as thematic-role assignment, where L1 influence can easily lead to a mistake, and thus result in

negative feedback, which might cause the parser to gradually abandon the inappropriate L1-based strategy. For other linguistic structures, the relationship between transfer and proficiency might be considerably different. Most notably, certain effects of L1 influence might sometimes only occur if the L2 speaker has already reached a certain level of proficiency. As already pointed out by Kellerman (1979), if a particular L2 structure is very complex, a beginning learner might not be proficient enough to process this structure successfully. If processing breaks down at a relatively early stage, an effect of L1 influence cannot emerge. An example of this is a longitudinal single-case-study by Sherwakh (1986) (quoted from Ellis, 1994), which investigated the use of direction-related expressions in L2 English by a native speaker of Punjabi. As a beginning learner of L2 English, the participant initially showed no signs of errors reflecting properties of his L1. However, such errors emerged after he had gradually become more proficient in the L2, and had acquired a greater variety of direction-related expressions. This is an important argument, especially given that a number of studies on L1 influence have used highly complex syntactic structures. To illustrate this problem, it is useful to revisit the following Greek example sentence from Papadopoulou & Clahsen (2003), discussed in Chapter 4:

- (22) Enas kirios fonakse ton fititi tis kathighitrias pu itan apoghoitevmenos apo to neo ekpedheftiko sistima.

(= A man called the student (masculine) of the teacher (feminine) who was disappointed (masculine) by the new educational system.)

For a sentence such as (22), a potential effect of L1 influence (in this case, a preference to attach the relative clause high or low depending on the respective L1) can only emerge if the L2 speaker is proficient enough to successfully solve a number of tasks. E.g., if the phrase *who was disappointed by the new educational system* is not correctly identified as a relative clause, it is impossible for an effect of L1 influence to occur. Furthermore, the ambiguity is resolved by complex morpho-syntactic information; an effect of L1 influence can only occur if the reader is proficient enough to process this information successfully.

To conclude, provided that L1 influence in L2 syntactic processing exists at all, it has to be assumed that L2 proficiency definitely affects L1 influence. While the exact nature of the relationship between proficiency and L1 influence depends on the particular sentences used in experimental research, this asks for an accurate documentation of L2 proficiency in all experiments addressing the issue of L1 influence.

L1 influence and working-memory span

A large number of studies on native-language sentence comprehension have shown that working memory plays an important role in sentence processing (e.g. Gibson, 1998; Clifton & Duffy, 2001). A number of psycholinguistic phenomena, such as pronoun resolution or filler-gap-dependencies, require the parser to store particular constituents in working memory, and to retrieve it later in the sentence. Consider the following example sentences (23) and (24):

(23) John and Sarah left the building that was very old, and he locked the door.

(24) The door that Peter unlocked was really huge.

In example sentence (23), the parser has to determine what constituent the pronoun *he* refers to. In other words, it is necessary to establish a connection between the pronoun *he* and the noun *John*. In order to achieve this, it is necessary to store the constituent *John* in working memory, and to retrieve it when the parser reaches the pronoun *he*. In example sentence (24), the subordinate clause *that Peter unlocked* contains a verb which is obligatorily monotransitive. However, the direct object of the verb *unlocked* is not included in the subordinate clause. In this respect, the sentence contains a gap after *unlocked*, which has to be filled with the filler *the door*. In order to determine the direct object of *unlocked*, the constituent *the door* has to be stored in working memory, and has to be retrieved when the parser reaches *unlocked*.

While the two example sentences involve different linguistic phenomena, the processing of both of these phenomena involves working memory in the sense that a constituent has to be stored, and retrieved later in the sentence, to solve a particular problem.

If working memory is involved in the processing of these linguistic phenomena, it is possible that individuals with a high working-memory span find it easier to process these phenomena than individuals with a low working-memory span. E.g. in example (23) above, the sentence contains a number of constituents between *John* and *he*, so a large amount of information has to be stored in working memory until the parser reaches the relative clause. While an

individual with a high working-memory span might find this relatively easy, the same task might be considerably more difficult for someone with a low working-memory span. For a sentence with an even larger distance between the pronoun and the noun it refers to, an individual with a low working-memory span might actually be unable to process the sentence, while someone with a high working-memory span could perhaps still be able to deal with the difficulties.

For native-language syntactic processing, it has been shown that differences in working-memory span can have an influence on how different individuals parse sentences (e.g. King & Just, 1991; Just & Carpenter, 1992). In this respect, working-memory span is a potential candidate for a variable which is able to explain why certain psycholinguistic effects only occur for some, but not for all participants. E.g., in a psycholinguistic experiment, it is possible that only a sub-group of participants with a high working-memory span shows a particular effect, while participants with a lower working-memory span do not. If two psycholinguistic experiments investigating the same question involve different groups of participants (e.g. different age groups, different levels of education, etc.), it is possible that results of the two experiments differ considerably because the group of participants in one experiment possessed a higher average working-memory-span than the group of participants in the other experiment.

This raises the question whether working-memory span can also, at least to some extent, explain why studies on L2 influence have led to opposing results.

It is possible that a particular sub-group of participants, e.g. individuals with a particular working-memory span, shows an effect of L1 influence, while other sub-groups of participants do not. This possibility is supported by the fact that, as already mentioned above, working-memory span has been shown to be a

potential moderator variable in the native-language processing of a number of linguistic phenomena, and some of these phenomena, such as relative-clause attachment ambiguities, have played a vital role in studies on L1 influence. To illustrate this, it is useful to have another look at the following example sentence from Papadopoulou & Clahsen (2003) described in Chapter 4:

(25) A man looked at the teacher of the pupil who was in the schoolyard.

As described in Chapter 4, this type of relative-clause-attachment ambiguity has been used in a number of studies on L1 influence. The relative clause *who was in the schoolyard* can be attached either to *the teacher* or to *the pupil*. In order to resolve this ambiguity, it is necessary to store the possible candidates *the teacher* and *the pupil*, to which the relative clause can theoretically be attached, in working memory, and to retrieve them when the parser reaches the relative clause. In this respect, working-memory span might play a role in the processing of such ambiguities: E.g., it is possible that an individual with a low working-memory span is unable to store the first candidate, *the teacher*, in working memory long enough. If *the teacher* is not stored in working memory anymore when the parser reaches the relative clause, there is no choice but to attach the relative clause to *the pupil*, because that is the only possible candidate which is still available. If this happens, an L2 speaker with a low working-memory span is unable to attach the relative clause high, and would have to choose low attachment, even if his own native language prefers high attachment. In this case, an L1 preference to favour high attachment cannot influence L2 processing. Thus, an effect of L1 influence could only occur for participants with a high

working memory span, who are able to store a constituent such as *the teacher* until they get to the relative clause.

It fits in well with such an account that, as already mentioned in Chapter 4, the first studies investigating the resolution of relative-clause attachment ambiguities in native English speakers (Frazier, 1978) actually considered the preference for low attachment found in native English reading to reflect a universal parsing mechanism called *late closure*. Low attachment was considered to be generally preferred because it required less processing resources than high attachment. It was shown later that *late closure* is not universal, and that a number of languages actually favour high attachment (see Chapter 4 for a more detailed discussion); however, it is still possible that in L2 processing, high attachment is relatively difficult for individuals with a low working-memory span. As a result, an effect of L1 influence might not occur for these individuals because of their limited working-memory resources.

While working-memory span could potentially play an important role in L1 influence, it is necessary to be cautious: While a number of studies (e.g. Ellis & Sinclair, 1996; Juffs, 2004; Sagarra & Herschensohn, 2010) have addressed the role of working memory span in other areas of L2 processing, almost no studies have explicitly investigated whether working-memory span can influence the role of the L1 in L2 processing. An exception to this is a study by Havik, Roberts, van Hout, Schreuder, and Haverkort (2009). In a self-paced reading experiment, the authors investigated how two groups of native speakers of German, with either a high or a low working-memory span, processed a type of subject/object-ambiguity in Dutch relative clauses, such as the one shown in example sentences (26a) and (26b) below:

(26a) Dat is de vrouw die de meisjes heeft gezien.

(This is the woman that the girls has seen.)

(26b) Dat is de vrouw die de meisjes hebben gezien.

(This is the woman that the girls have seen.)

Both Dutch sentences are temporarily ambiguous: When the parser reaches *de meisjes*, it is unclear whether this noun is the subject or the object of the relative clause. In both sentences, the ambiguity is resolved at the subordinate verb: In sentence (26a) the form of the verb *heeft* indicates that the verb refers to a singular subject, but *de meisjes* is plural, so the verb can only refer to *de vrouw*; as a result, *de meisjes* can only be interpreted as a direct object. In sentence (26b), the form of the verb *hebben* indicates that the verb refers to a plural subject, but *de vrouw* is singular, so the verb can only refer to *de meisjes*; as a result, *de meisjes* can only be interpreted as a subject. The authors showed that both native speakers of Dutch and native speakers of German, when reading in their respective native languages, initially show a preference to interpret the temporarily ambiguous noun as a subject, and experience difficulty when the ambiguity is resolved in favor of an object interpretation. Thus, if native speakers of German reading in L2 Dutch are influenced by properties of their L1, they should show a preference to interpret the ambiguous noun as a subject, especially given that this is not only the preferred interpretation in their L1, but also the interpretation preferred by native speakers of the L2 language. The authors also manipulated task demands: In one condition, participants simply had to read the

sentences for comprehension, while in another condition, they also had to answer questions. The authors found that working-memory span only had an effect on processing if task demands were high; if participants just read the sentences for comprehension, the high- and low- span groups did not differ. Additionally, results also showed no effect of L1 influence: Even though both their L1 and the L2 favored the subject interpretation, L2 readers showed no clear preference for the subject interpretation while reading the Dutch sentences. Nevertheless, the study deserves to be mentioned as a valuable first step towards understanding the possible role of working-memory span in the area of L2 processing.

Even if it is the case that working-memory span has an effect on L1 influence, the fact that studies on L1 influence have led to opposing results cannot be explained by differences in working-memory span alone: It is very unlikely that just by chance, all studies which found an effect of L1 influence are based on participants with a high working-memory span, while all studies which did not find such an effect are based on participants with a considerably lower working-memory span. Furthermore, not all studies on L1 influence are based on linguistic phenomena for which working-memory span has been shown to play a role: While research on native processing suggests that working-memory span can influence the processing of relative-clause attachment ambiguities, it is unclear whether this is also the case for other phenomena which have been used to study L1 influence, such as cross-linguistic syntactic priming (see Chapter 3), or for tasks such as the sentence-interpretation paradigms used in studies on the Competition Model (see Chapter 2). In this respect, working-memory span, while a variable which definitely deserves to be taken into account in studies on L1

influence, cannot be considered a complete solution to the problem of the opposing results in the area.

L1 influence and L1-L2 similarity

Intuitively, it is quite plausible to assume that effects of L1 influence are stronger, or at least more likely to occur, if the L1 and L2 are relatively similar to each other. In this respect, two different accounts of L1-L2 similarity must be distinguished.

First, it is possible that the *specific* similarity between two languages (*specific* in the sense that it refers the particular linguistic phenomenon under investigation, rather than to broad, general similarity between two languages) has an effect on L1 influence. For example, the study by Sabourin (2003), described in Chapter 4, showed that native speakers of German were as sensitive to violations of grammatical gender agreement as native speakers, while this was more difficult for native speakers of Romance languages, and most difficult for native speakers of English. In this particular study, the differences between the three L1 groups could be explained by the fact that German is very similar to Dutch with regard to grammatical gender, while romance languages have gender systems which are very different from Dutch, and while English has no grammatical gender at all. In other words, the degree of similarity between the L1 and L2 grammatical gender systems had an effect on processing difficulty. A similar example is the cross-linguistic syntactic priming study by Loebell & Bock described in Chapter 3. In this study, the authors found a cross-linguistic syntactic priming effect from English to German for PO-DO priming, but not for

active-passive priming. The authors argued that PO-DO priming can occur because prepositional objects and double objects possess the same word order in English and German, while active-passive priming cannot occur because in passive sentences, the word order in German sentences differs from the English word order. In other words, Loebell & Bock (2003) can be considered a case where the degree of similarity between L1 and L2 regarding the specific syntactic structures under investigation could explain why an effect of L1 influence occurred in some, but not in all cases.

Second, it is also possible that the *overall* similarity between the L1 and L2 has an effect on L1 influence. E.g., English and German are generally considered relatively similar on a number of levels: Both are Indo-European languages, both share the same alphabet, the word-order in main clauses is identical, both languages share a large number of cognates, etc. It is possible that because of this general similarity between the two languages, effects of L1 influence are more likely to occur than for language pairs with a lesser degree of similarity. This might explain why at least some of the studies described in Chapters 3 and 4 did not find an effect of L1 influence, while other studies did. E.g., in Papadopoulou & Clahsen's (2003) study on relative-clause-attachment preferences in L2 Greek described in Chapter 4, the L2 group consisted of native speakers of German, Russian, and Spanish. While the authors argued that all three languages are similar to Greek in the sense that they share the same preference for high attachment, it could be argued that on a more general level, Greek is considerably different from these three languages. This might explain why the L2 group did not show a preference for high attachment, even though both their L1 and the L2 favour high attachment.

A possible effect of L1-L2 similarity on L1 influence has been investigated on the lexical and pragmatic levels of language processing and production, such as word recognition (Muljani, Koda, and Moates, 1998), the avoidance of idioms (Laufer, 2000) or the avoidance of specific types of verbs (Laufer & Eliasson, 1993). Also, many of the studies described in Chapters 2-4 have discussed the possible role of L1-L2 similarity. However, at least to date, no experimental studies on syntactic processing have attempted to use L1-L2 similarity as an independent variable to measure a possible effect on L1 influence. Presumably, the reasons for this are methodological: Most experimental approaches described in the previous chapters simply require a specific degree of L1-L2 similarity in order to be able to measure L1 influence. E.g., in the case of specific L1-L2 similarity regarding a particular structure, studies on RC-attachment preferences require that relative-clause-attachment ambiguities exist in both the L1 and the L2. If the particular structure does not exist in one of the languages, L1 influence simply cannot be measured. Also, the use of L1-L2 similarity as an independent variable is very likely to be problematic because of the large number of possible confounds: If L1-L2 similarity is manipulated, e.g. by conducting a study with two or more groups of L2 speakers from different L1 backgrounds, it is likely that the L2 groups do not only differ in terms of L1-L2 similarity, but also in terms of a large number of other variables.

Finally, it deserves to be pointed out that while L1-L2 similarity can possibly explain why some of the studies discussed in Chapters 2-4 have come to different conclusions regarding L1 influence, this is not the case for all studies: E.g., in Dussias' (2003) questionnaire study on relative-clause-attachment

preferences described in Chapter 3, an effect of L1 influence occurred for native speakers of English reading L2 Spanish sentences, but not for native speakers of Spanish reading L2 English sentences. Nevertheless, even the few studies related to the issue (e.g. Loebell & Bock, 2003; Sabourin, 2003) are at least consistent with the possibility that L1-L2 similarity affects L1 influence to some extent. Thus, L1-L2 similarity can therefore be considered a fruitful topic for further research on L1 influence in syntactic processing.

L1 influence and stages of processing

In psycholinguistic research on native language sentence processing, a number of important controversies concentrate on the question *when* a particular effect occurs, with a large body of research trying to distinguish between effects of early and effects of late processing. With regard to L1 influence in L2 syntactic processing, this question has not been investigated. This is understandable, especially given that it is already controversial whether effects of L1 influence exist at all. As a result, both models discussed in Chapter 2 do not distinguish between early and late effects of L1 influence, and most studies described in Chapters 2-4 do not try to disentangle early and late effects. Nevertheless, it is useful to discuss at what stage such an effect might occur, especially given that it might result in important methodological consequences (see below).

One possibility is that during processing of an L2 sentence, L2 speakers might initially activate an L1 structure (at least as long as there is an L1 structure which matches the properties of the L2 sentence), for example because access to L1 grammar has become highly automatic over the years. At later stages of syntactic processing, which may be less automatic and more strategic, they might

then suppress their L1 grammar, because they acknowledge that the sentence is in L2. Following this account, an effect of L1 influence would be relatively short-lived, and would thus only occur in early measures.

Alternatively, it is also possible that L2 speakers normally activate L2 structures first, and resort to L1 structures only if they encounter difficulties. For example, if an L2 structure is so complex that an L2 speaker is unable to deal with it, he might use L1 grammar as a last resort. If this is the case, an effect of L1 influence would only emerge in later measures.

On a methodological level, the studies described in Chapters 2-4 have made use of a wide range of different methodological approaches, from questionnaire studies and sentence-interpretation to self-paced reading, eye-tracking, and EEG measures. It is likely that these different methods measure L1 influence at different stages of processing: For example, off-line methods such as the sentence-interpretation paradigm refer to the ultimate outcome of processing, the final representation of a sentence. In other words, these methods measure L1 influence at a very late stage, when syntactic processing is already complete. A method such as self-paced reading, in contrast, measures effects while processing proceeds, and does so separately for each constituent. Finally, eye-tracking, by distinguishing between measures of early processing (such as first-pass reading times) and measures of relatively late processing (such as total times), allows for a distinction between early and late effects.

As a result, if effects of L1 influence only occur at some, but not all stages of processing, the effect would only be detected by those methodological approaches which measure L1 influence at the specific stages at which the effect occurs. To illustrate this, it is useful to have another look at Frenck-Mestre &

Pynte's (1997) eye-tracking study on sub-categorization frames discussed in Chapter 4. In their study, the authors compared sentences containing verbs which either share the same sub-categorization frame in L1 French and L2 English (such as *bark*) with sentences containing verbs with a different sub-categorization frame in L1 and L2 (such as *obey*), and found longer first-pass reading times at the verb for verbs such as *obey* than for verbs such as *bark*. This effect, however, only occurred at the verb itself, but not in later segments of the sentence. Furthermore, the effect also only occurred for first-pass reading times, but not for later measures. Thus, the study suggests that the L2 speakers experienced L1 influence (in the sense that they activated the L1 sub-categorization frame while reading the L2 verb) at an early stage, but this effect of L1 influence was very short-lived, and did not affect subsequent processing of other segments.

Thus, Frenck-Mestre & Pynte (1997) suggests that effects of L1 influence might occur early in processing, and are not detected by later measures because they are relatively short-lived. However, other studies, such as Hernandez, Bates, and Avila (1994), described in Chapter 2, or I-Ru Su (2001), described in Chapter 6, suggest the opposite: Both of these studies found effects of L1 influence in an off-line sentence-interpretation task. In other words, in these studies, L1 influence persisted after syntactic processing was complete, and affected the ultimate interpretation of the sentence. In this respect, it has to be concluded that L1 influence can sometimes be an early and short-lived phenomenon, but can in other cases also occur at a fairly late stage of processing.

CHAPTER 6

Experiments 1-4:

The Activation of L1 Syntactic Structures during L2 Processing

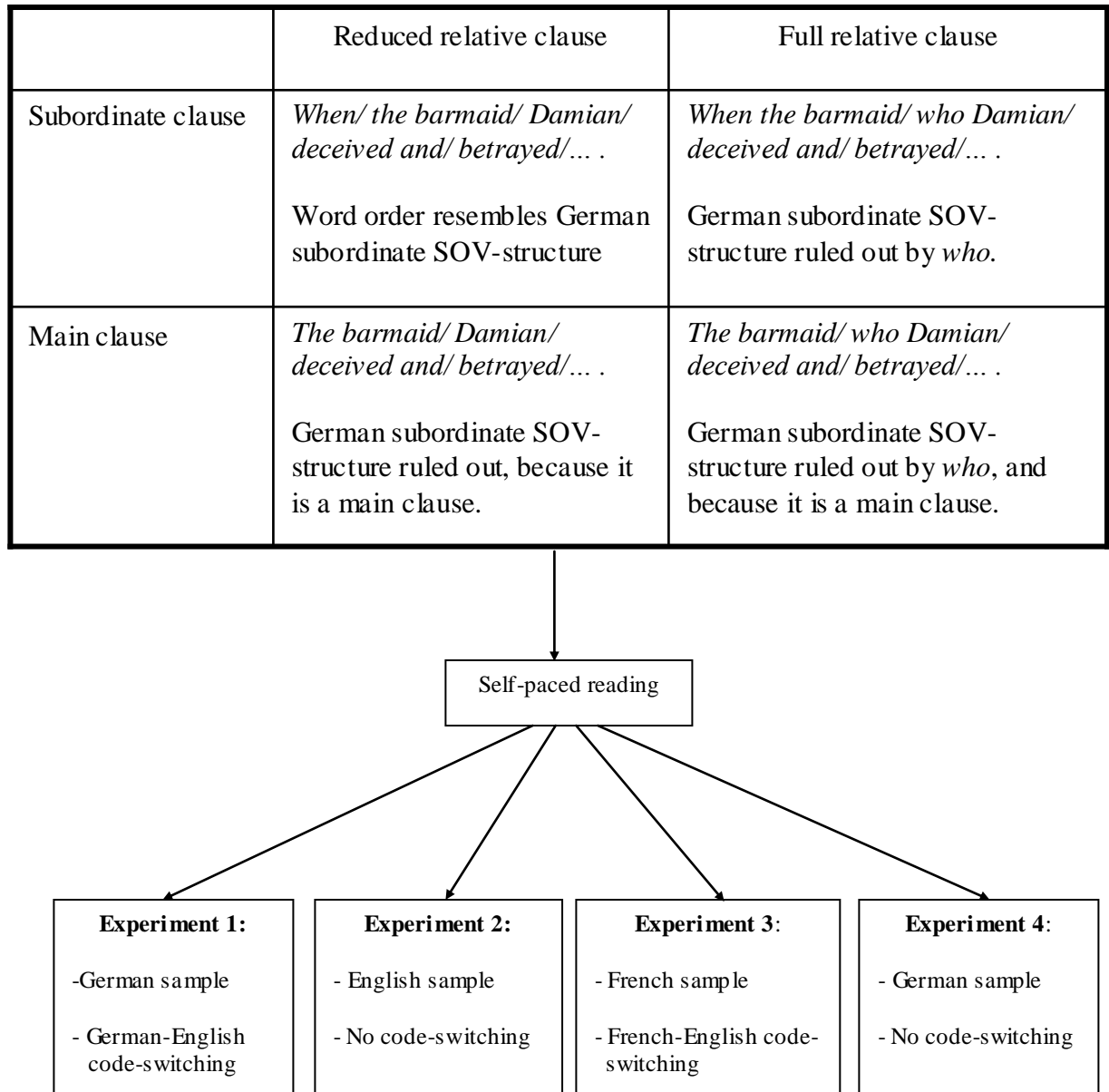


Figure 1. Plan of Experiments in Chapter 6.

As already mentioned in Chapter 2, current models of L2 sentence processing differ regarding the issue of a possible influence of syntactic properties of the L1 in L2 syntactic processing. According to Clahsen & Felser's (2006) shallow-structure account, L2 readers compute only a very shallow representation of the syntactic structure of an L2 sentence. This representation is considered not detailed enough for syntactic properties of the L1 to have an influence; therefore, syntactic properties of the L1 should not affect L2 sentence processing. According to the Competition Model (MacWhinney, 1997), in contrast, L1 and L2 processing are conducted by the same processing mechanisms; as a result, the Model predicts strong L1 influence effects on all levels of language processing.

Because the models mentioned above make different predictions regarding the influence of the L1 in L2 syntactic processing, investigating possible effects of L1 influence can be used as a tool to directly compare these models. In the following four experiments, I investigate how L2 speakers process sentences with a word order that is grammatically correct in both their L1 and their L2, but represents different underlying syntactic structures in the two languages. Consider a sentence beginning such as (27):

(27) When the barmaid Damian deceived and betrayed... .

In sentence (27), "Damian deceived and betrayed" is a reduced relative clause, the full version being "who Damian deceived and betrayed". The word order of this sentence, however, resembles a German subordinate SOV-structure. German is verb-final in subordinate clauses, so the word order of

the German translation equivalent of a sentence such as “When the barmaid deceived and betrayed Damian... .” would be “When the barmaid Damian deceived and betrayed... .”, which is exactly the word order in sentence (27). In this respect, the word order in sentence (27) is grammatically correct in both English and German, but represents different underlying syntactic structures in the two languages. Thus, if native speakers of German processed “When the barmaid Damian deceived and betrayed...” according to German syntax, they would incorrectly analyse it as a subordinate clause, with “Damian” being the direct object (as in “Als die Bardame Damian hinterging und betrog...”). If the parser activates not only the correct English structure, but also the German structure, this should result in processing difficulty.

To illustrate the basic rationale behind the four experiments presented below, it is useful to compare sentences such as (27) above with so-called garden-path-sentences, such as sentence (28) below:

(28) While the man hunted the deer ran into the woods.

When reading a sentence such as (28) from left to right, *the deer* initially appears to be the direct object of the verb *hunted*. At *ran*, however, it becomes clear that *the deer* is not a direct object, but actually the subject of the upcoming main clause. In this respect, the syntactic structure of the sentence (specifically, the syntactic function of the constituent *the deer*) is temporarily ambiguous until the parser reaches the disambiguating main verb *ran*.

A considerable body of research (e.g. Frazier, 1978, 1987; Frazier & Rayner, 1982; Ferreira & Henderson, 1991; Pickering & Traxler, 1998; Van Gompel, Pickering, Pearson, & Jacob, 2006) has investigated how native speakers process garden-path sentences such as (28), showing that typically, readers initially prefer to attach a constituent such as *the deer* in sentence (28) to the verb *hunted*. When this syntactic structure is ruled out by the verb *ran*, readers are forced to reanalyze.

In how far does L2 processing research based on sentences such as (27) resemble research on ambiguity resolution based on temporarily ambiguous sentences such as (28)? In sentence (28), the parser has to make a decision between two different syntactic structures. The beginning of the sentence (*While the man hunted the deer...*) is consistent with both of these structures, and only later input (*ran*) clarifies which of these structures is the correct one. The beginning of sentence (27) is also consistent with two syntactic structures, one from L2 English, the other from L1 German. Thus, a native speaker of German who reads an English sentence such as (27) might face a similar problem as a native speaker who reads a sentence such as (28): If syntactic information from the L1 has an influence on L2 processing, a native speaker of German who reads an English sentence such as (27) might activate the German subordinate SOV-structure, and might be forced to reanalyse when this structure is ruled out later in the sentence. Hence, sentences such as (27) could be referred to as cross-linguistic garden-path sentences.

Experiment 1

The experiment explores whether L2 speakers activated syntactic structures from their L1 while reading L2 sentences. Native speakers of German read English sentences such as (29a) and (29b):

(29a) When the barmaid Damian deceived and betrayed attempted to steal the spoons nobody paid attention.

(29b) The barmaid Damian deceived and betrayed attempted to steal the spoons when nobody paid attention.

In (29b), the German SOV-structure is ruled out from the start: *Damian* cannot be a direct object here because German main clauses require SVO-word-order. Hence, if syntactic transfer occurs in (29a), native speakers of German should find (29a) harder to process than (29b).

To rule out the possibility that a difference between (29a) and (29b) occurs because (29a) starts with a subordinate clause and (29b) with a main clause, we added conditions (29c) and (29d), which parallel (29a) and (29b), but contain a “who” to introduce the relative clause:

(29c) When the barmaid who Damian deceived and betrayed attempted to steal the spoons nobody paid attention.

(29d) The barmaid who Damian deceived and betrayed attempted to steal the spoons when nobody paid attention.

Because both sentences (29c) and (29d) contain a *who* to introduce the relative clause, neither sentence resembles a German subordinate SOV structure. If a difference in processing difficulty between sentences (29a) and (29b) is due to the fact that (29a) starts with a subordinate clause while (29b) starts with a main clause, we should observe the same difference in processing difficulty between (29c) and (29d). If, however, difficulty to process sentence (29a) reflects an effect of L1 influence, we expect a statistical interaction type of sentence beginning (subordinate vs. main clause) x type of relative clause (reduced vs. full relative clause).

Note that it is this interaction, rather than a simple comparison between sentences (29a) and (29b), which constitutes the critical test for a possible effect of L1 influence: It is possible that main clauses actually take longer for L2 speakers to process than subordinate clauses (e.g. because they spend most of their time at what they consider to be the most important part of the sentence, the main clause, and devote less time to subordinate clauses.). If this is the case, it might result in a lack of a difference between (29a) and (29b): The fact that (29a) matches a German structure might make (29a) harder to process than (29b), but the fact that it starts with a subordinate clause might make (29a) easier. If both effects cancel each other out, sentences (29a) and (29b) would not differ, but the interaction type of relative clause x type of sentence beginning would still be significant.

Method

Participants. 32 native speakers of German living in Scotland at the time of testing participated in the study for payment. All participants had originally learned English as a foreign language at school for at least 9 years, and had afterwards moved to Scotland.

Items. We constructed a total of 40 sets of experimental items (see Appendix A). Each set consisted of four conditions; an example is displayed in Figure 2.

	Reduced relative clause	Full relative clause
Subordinate clause	<i>When the barmaid Damian deceived and betrayed attempted to steal the spoons nobody paid attention.</i>	<i>When the barmaid who Damian deceived and betrayed attempted to steal the spoons nobody paid attention.</i>
Main clause	<i>The barmaid Damian deceived and betrayed attempted to steal the spoons when nobody paid attention.</i>	<i>The barmaid who Damian deceived and betrayed attempted to steal the spoons when nobody paid attention.</i>

Figure 2: Conditions in Experiment 1.

In subordinate/reduced relative condition, the sentence always started with a subordinate conjunction (e.g. *When*), followed by a definite subject noun phrase (e.g. *the barmaid*, subject of the subordinate clause), then a proper

name (e.g. *Damian*; subject of the reduced relative clause), two coordinated verbs (e.g. *deceived and betrayed*, main verbs of the reduced relative clause), and a complex verb (e.g. *attempted to steal*, including the main verb of the subordinate clause). While the correct English structure is a reduced relative clause embedded in a subordinate clause, the word order resembles a German subordinate SOV-structure. The main/reduced relative condition is identical, except for the fact that the subordinate conjunction is missing. Because German is only verb-final in subordinate clauses, but not in main clauses, the structure of the main/reduced relative condition does not resemble a German structure. The subordinate/full relative and main/full relative conditions resemble the first two conditions, but contain a full relative clause instead of a reduced one. In both the subordinate/full relative condition and in the main/full relative condition, the presence of the *who* rules out the German SOV-structure.

Design. Four lists were constructed, each comprising ten items from each condition, with each list containing exactly one of the four versions of each item.

We added a total of 80 filler items with a variety of syntactic structures. To ensure that both linguistic systems are active during testing, 40 of these fillers were German, making the experiment a code-switching task. For the 40 German filler sentences, we avoided syntactic structures for which the correct English translation equivalent would have a different word order. In other words, for all 40 German fillers, a direct word-by word translation

into English was possible, the result being a grammatically correct English sentence with the same meaning as the German sentence.

To ensure that participants actually processed the items, a third of all experimental sentences and a third of all fillers were followed by a comprehension statement. For each statement, participants had to judge whether the meaning of the comprehension statement was correct or not when compared with the meaning of the last sentence they had just read before. For half of these comprehension statements, the correct response was “yes,” for the other half, it was “no.”

Procedure. Prior to the experiment, participants were asked to fill in two English proficiency tests -Part 1 of the Grammar section of the Oxford Placement Test (Allan, 2004) and the Meara Test (Meara, 1996; Lemhöfer, Dijkstra, & Michel, 2004)- to measure syntactic and lexical English proficiency.

In the experiment, the items were shown on a 17 inch monitor using the DMDX experiment software (Forster & Forster, 2003). The sentences were presented using the phrase-by-phrase self-paced reading technique. Each sentence was segmented into a number of phrases, such as *When the barmaid/ Damian/ deceived and/ betrayed/ attempted to/ steal/ the spoons/ nobody/ paid attention./* The segmentation for all experimental sentences is shown in Appendix A. Participants first saw the first phrase of each sentence on the left side of the screen; after having read the phrase, they proceeded to the next phrase by pressing a button on a button box attached to the PC. Each time they pressed the button, the respective phrase disappeared, and the next

phrase of the sentence appeared on the right-hand side of the position where the previous phrase had been shown. Participants proceeded through the sentence by pressing the button repeatedly. Reading times for each phrase were recorded on each button press. Participants gave answers to comprehension questions by using “yes”- and “no” buttons on the button box.

Instruction. Participants were instructed to read the sentences silently for themselves, and to read as naturally and fluently as possible, at their normal reading speed. Instructions were given orally in English.

Results

Proficiency. Participants completed part 1 of the Grammar section of the Oxford Placement Test (OPT), measuring grammar proficiency, and the Meara Test, measuring lexical proficiency. The OPT consists of a total of 50 multiple-choice-items; participants are supposed to fill 50 gaps in a number of English sentences in a grammatically correct way. For each gap, 3 possible solutions are given; only one of these 3 is grammatically correct. Participants receive 1 point for each correctly filled gap.

To be able to interpret how proficient participants actually were, we compared participants' OPT scores with OPT scores from a control sample of 32 native speakers of English (the participants from Experiment 2, see below), and with results from a norming sample of 32 native speakers of German that we had tested in Germany, in their final year at secondary school, after they had studied English at school for 9 years. Results for all 3 groups are shown in Figure 3. While OPT scores of the participant group

were significantly lower than the scores of the native control sample ($t(62) = 5.10, p < .001$), their proficiency was significantly higher than the proficiency of the German norming sample ($t(62) = 3.93, p < .001$).

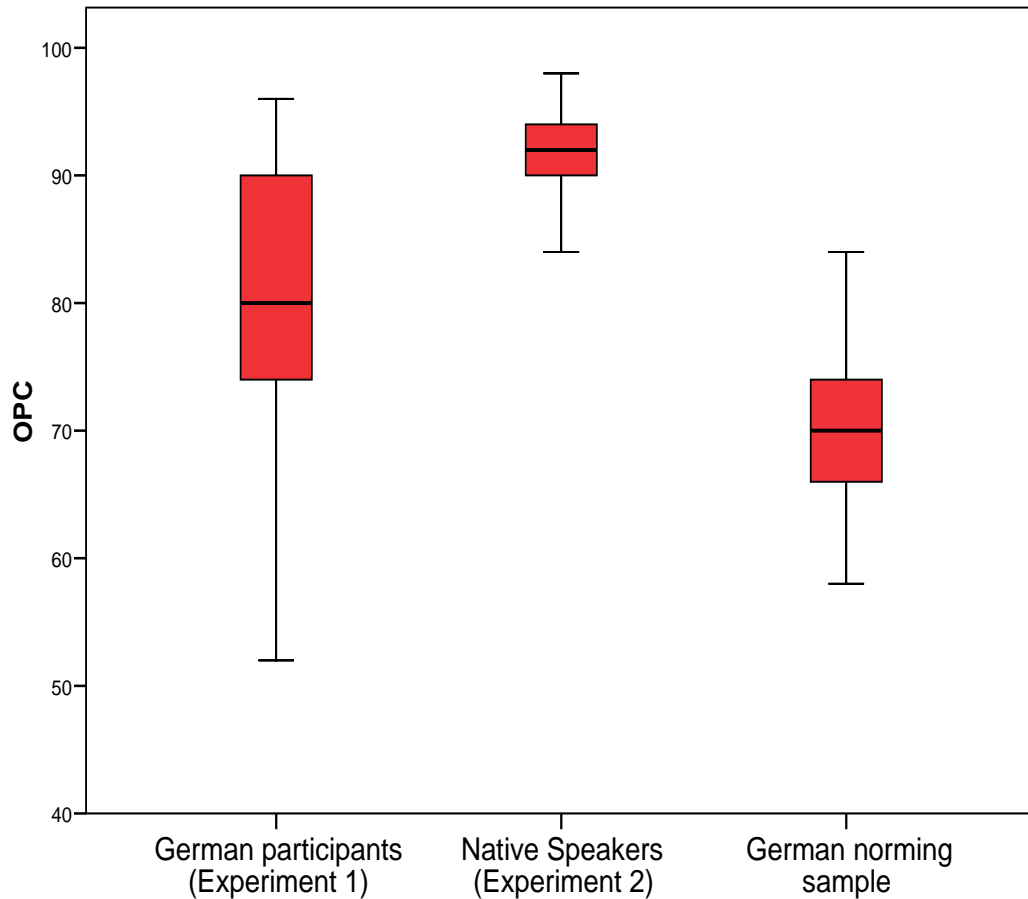


Figure 3: OPC proficiency scores in Experiments 1 and 2

The Meara Test is a lexical decision test consisting of 60 words. For each word, participants have to decide whether this word actually exists in the English language, or whether it is a non-word. Participants receive 1 point for every correctly categorized word. Figure 4 shows results for this test, again together with results for the native English control sample and the German norming sample. Results basically mirror the results for grammar proficiency,

with the participants' scores being significantly lower than the scores of the native sample, but significantly higher than the German norming sample.

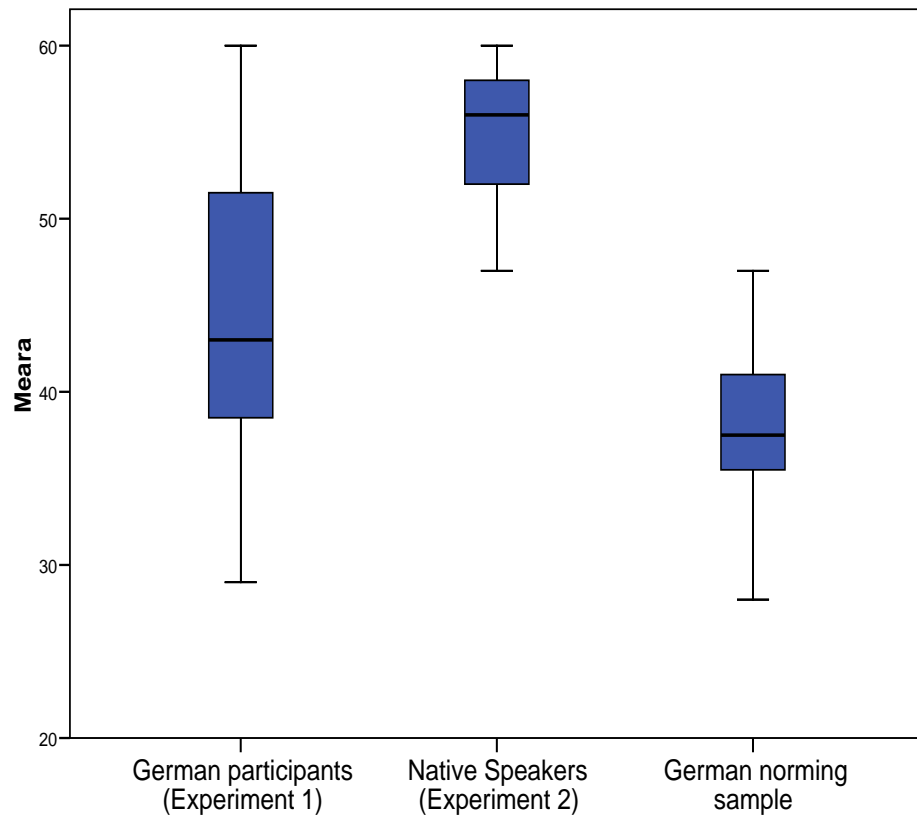


Figure 4: Meara Proficiency Scores for Experiment 1 and 2.

To conclude, given that even the significantly less proficient German norming sample had already learned English at school for 9 years, participants' English proficiency can be assessed as very high. The fact that the variance of participants' scores was considerably larger than in the German norming sample in both tests is most likely due to the fact that all members of the norming sample were of the same age, had been learning English at the same school, had been taught by the same teachers, and had studied English for the same number of years.

Exclusions. Two participants had to be excluded from the analyses because their native-language-status was not clear; two more participants were recruited to replace them. We excluded reading times below 150 ms and above 2500 ms.

Reading times. Mean reading times for the different segments of the sentence are shown in Figure 5, and exact values for means by condition by segment in Table 1.

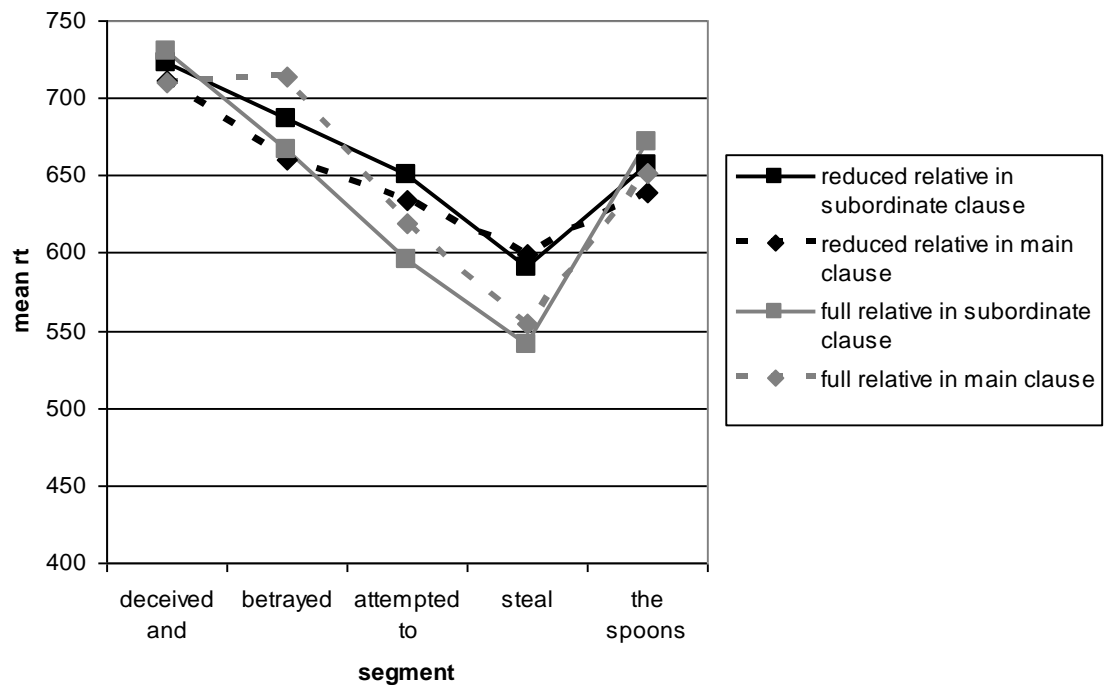


Figure 5: Mean Reading Times by segments for native speakers of German in Experiment 1.

Table 1
Experiment 1: Means

Condition	Segment deceived and ⁴	betrayed	attempted to	steal	the spoons
reduced relative in subordinate clause	723.08	686.77	650.18	590.30	656.40
reduced relative in main clause	711.67	660.23	634.63	598.80	639.75
full relative in subordinate clause	730.68	666.89	595.04	541.31	672.09
full relative in main clause	710.59	713.64	619.04	554.17	651.01

For each of the five segments shown in Figure 4, we conducted two 2 (type of relative clause, reduced vs. full) x 2 (type of sentence beginning, subordinate clause vs. main clause) x 4 (list) ANOVAs, one by subjects, one by items. List was only included as an additional factor to account for possible error variance based on list (Pollatsek & Well, 1995). Therefore, effects which include the factor list are not reported.

deceived and. Results for the *deceived and*-segment showed no main effects of relative clause; $F_1 < 1$; $F_2 < 1$; or of sentence beginning; $F_1 (1,28) = 1.87$, $p > .1$; $F_2 < 1$. Results also show no interaction between relative clause and sentence beginning; $F_1 < 1$; $F_2 < 1$.

betrayed. For the *betrayed*-segment, results showed no main effects of relative clause; $F_1 (1, 28) = 1.42$, $p > .1$; $F_2 < 1$; or of sentence beginning; $F_1 < 1$; $F_2 < 1$. However, the interaction between relative clause and sentence beginning was significant; $F_1 (1, 28) = 7.24$, $p < .05$; $F_2 (1, 36) = 5.32$, $p < .05$. Planned comparisons revealed significantly longer reading times for the

⁴ For the sake of simplicity, I refer to all segments of the sentence by using words from the example sentence. In this respect, *attempted to* refers to the first part of segment containing the coordinated subordinate verb, *betrayed* refers to the section containing the second part of the subordinate verb, and so on.

reduced relative clause embedded in a subordinate clause than for the reduced relative clause embedded in a main clause in the by-subjects analysis, but not in the by-items analysis; $F_1(1, 28) = 5.26, p < .05$; $F_2(1, 36) = 1.59, p > .1$. Planned comparisons for the two conditions with a full relative clause showed a reverse pattern, with significantly shorter reading times for the full relative clause embedded in a subordinate clause than for the full relative clause embedded in a main clause; $F_1(1, 28) = 4.12, p < .05$; $F_2(1, 36) = 4.34, p < .05$.

attempted to. For the *attempted to*-segment, the main effect of relative clause was non-significant by subjects, and only marginally significant by items; $F_1(1, 28) = 2.73, p > .1$; $F_2(1, 36) = 3.30, p < .1$. Results showed no main effect of sentence beginning; $F_1 < 1$; $F_2 < 1$; and also no interaction between relative clause and sentence beginning; $F_1(1, 28) = 1.75, p > .1$; $F_2(1, 36) = 1.81, p > .1$.

steal. Results for the *steal*-segment showed a significant main effect of relative clause; $F_1(1, 28) = 12.53, p < .01$; $F_2(1, 36) = 14.01, p < .01$, with shorter reading times for sentences with a full relative clause than for sentences with a reduced relative clause. The main effect of sentence beginning was non-significant; $F_1 < 1$; $F_2 < 1$; as was the interaction between relative clause and sentence beginning; $F_1 < 1$; $F_2 < 1$.

the spoons. For the *the spoons*-segment, we found no main effect of relative clause; $F_1(1, 28) = 1.80, p > .1$; $F_2 < 1$. The main effect of sentence

beginning was significant by subjects, but not by items; $F_1(1, 28) = 5.12$, $p < .05$; $F_2 < 1$. The interaction between both variables was non-significant; $F_1 < 1$; $F_2 < 1$.

Preliminary summary and discussion.

The fact that we found an interaction between type of sentence beginning and type of relative clause at *betrayed* is consistent with the idea that L2 readers activated the German syntactic structure while processing the English sentence: At *betrayed*, the subordinate/reduced relative condition, which resembles a syntactic structure from L1 German, was more difficult to process than the main/reduced relative condition⁵; however, if the sentences contained a *who* to rule out the potentially interfering German structure, the difference was the other way round, with the main/full relative condition being more difficult to process than the subordinate/full relative condition. Note again that this pattern of results cannot be explained by the fact that the subordinate/reduced relative condition starts with a subordinate clause, while the main/reduced relative condition starts with a main clause: If this was the case, then the subordinate/full relative condition, which also starts with a subordinate clause, should also be more difficult to process than the main/full relative condition.

Thus, this suggests that the parser activated syntactic information from the L1 while processing sentences from the subordinate/reduced relative condition, because the word order resembles a syntactic structure from the L1.

⁵ Please note that in the planned comparisons, this difference only reached significance in the by-subjects analysis.

When the parser notices that the German syntactic structure does not fit in with the language of the sentence, this causes difficulty. This results in the reading time pattern we found in the *betrayed*-segment.

The fact that the interaction occurred at *betrayed*, rather than at another segment of the sentence, deserves a closer look. At *betrayed*, the German word-by-word-translation of sentences from the subordinate/reduced relative-condition is still grammatical; it only becomes ungrammatical at *the spoons*. This suggests that the parser notices relatively early in the sentence that the German structure is impossible, already before it is ruled out by the word order itself. Two possible explanations why the effect occurs in this segment deserve to be mentioned: First, while the interfering L1 structure is still grammatical at *betrayed*, its frequency drops considerably at this segment. Before *and betrayed*, the structure of the L1 word-by-word translation (a subject, direct object and verb embedded in a subordinate clause) is highly frequent, but the use of a coordinated verb (*deceived and betrayed*) is relatively infrequent in German subordinate clauses. Thus, it is possible that the parser abandons the L1 syntactic structure at *betrayed* because the German structure, while still grammatical, is suddenly relatively infrequent. Second, it is possible that the interaction at *betrayed* reflects a clause-wrap-up effect: When reaching the end of the coordinated verb, the parser might double-check whether the two arguments *the barmaid* and *Damian* are attached to the verb in the correct way, and might in the process realize that the L1 structure is inappropriate for an English sentence. While it is impossible to distinguish between these two possibilities, both explanations

assume that the parser temporarily activated an L1 structure while processing an L2 sentence.

In addition to the interaction at *betrayed*, results also showed a main effect of type of subordinate clause (reduced relative vs. full relative) at *steal*, reflecting that the parser finds it easier to perform a syntactic analysis in the presence of the additional function word *who*. The presence of *who* clarifies the levels of embedding that the sentence contains, possibly making it easier to integrate new constituents into the syntactic analysis. This might explain why this main effect occurs relatively late in the sentence.

The fact that the main effects of relative clause of sentence beginning occur relatively late rules out the possibility that the interaction observed at *betrayed* is actually not caused by L1 influence, but instead by a type of processing overload effect: If such main effects had occurred at *betrayed* or at least at *deceived and*, one could have assumed that both the exclusion of *who* and beginning the sentence with a subordinate clause add a certain amount of processing difficulty; when both of these occur together, processing breaks down, resulting in an interaction. If this scenario were correct, we should have observed such main effects at *betrayed*. The data pattern, however, just shows an interaction, but no signs of a main effect before or at *betrayed*. Thus, we conclude that the interaction at *betrayed* cannot be explained by processing overload.

In the absence of a native English control group, it is at least theoretically possible that the interaction observed at *betrayed* does not reflect processes of L1 influence, but a general type of difficulty that all readers, native or non-native, experience with the particular syntactic structures. To

rule out this possibility, we replicated the experiment with a group of native English participants.

Experiment 2

Experiment 2 aims to rule out the possibility that the interaction found for L2 readers in Experiment 1 reflects a type of general processing difficulty with the particular structures used in the experiment. If the interaction really reflects processes of L1 influence, the effect should only occur for L2 readers, but not for native readers.

Method

Participants. 32 native speakers of English from the Dundee area participated in the study. All participants reported that they considered themselves monolingual native speakers of English, with no knowledge of German, and only basic knowledge of other foreign languages. None of the participants had spent extended periods in none-English-speaking countries.

Items. The same 40 experimental items as in Experiment 1 were used.

Design. The same four lists as in Experiment 1 were used. Because none of the participants had knowledge of German, the 40 German filler items in

these lists were translated into English. The translated versions were included in the same positions in which their respective German versions had occurred in Experiment 1.

Procedure. Participants were tested in the same laboratory and using the same equipment as participants in Experiment 1. In order to obtain a control sample for the proficiency data from Experiment 1, all native English participants also completed the two English proficiency tests prior to the experiment. Subsequently they were asked to complete the pretest, then the actual experiment.

Instruction. Instructions were identical to the ones given to the L2 group. Just like for the L2 group, instructions were given orally in English.

Results

Exclusions. Reading times below 150 ms and above 2500 ms were excluded.

Proficiency data. In order to obtain a control sample for the proficiency scores of the L2 participants in the other experiments, the native speakers in Experiment 2 completed the OPC test and the Meara test. The results are shown in Figures 3 and 4 above, in the section on Experiment 1.

Reading times. Again, we excluded reading times below 150 and above 2500 ms. Mean reading times for the different segments and conditions are shown in Figure 6, with exact values for means by condition by segment being

shown in Table 2. As in Experiment 1, we conducted two 2 (type of relative clause) x 2 (type of sentence beginning) x 4 (list) ANOVAs, one by subjects, the other by items, for each segment. Effects which involve the factor list are not reported.

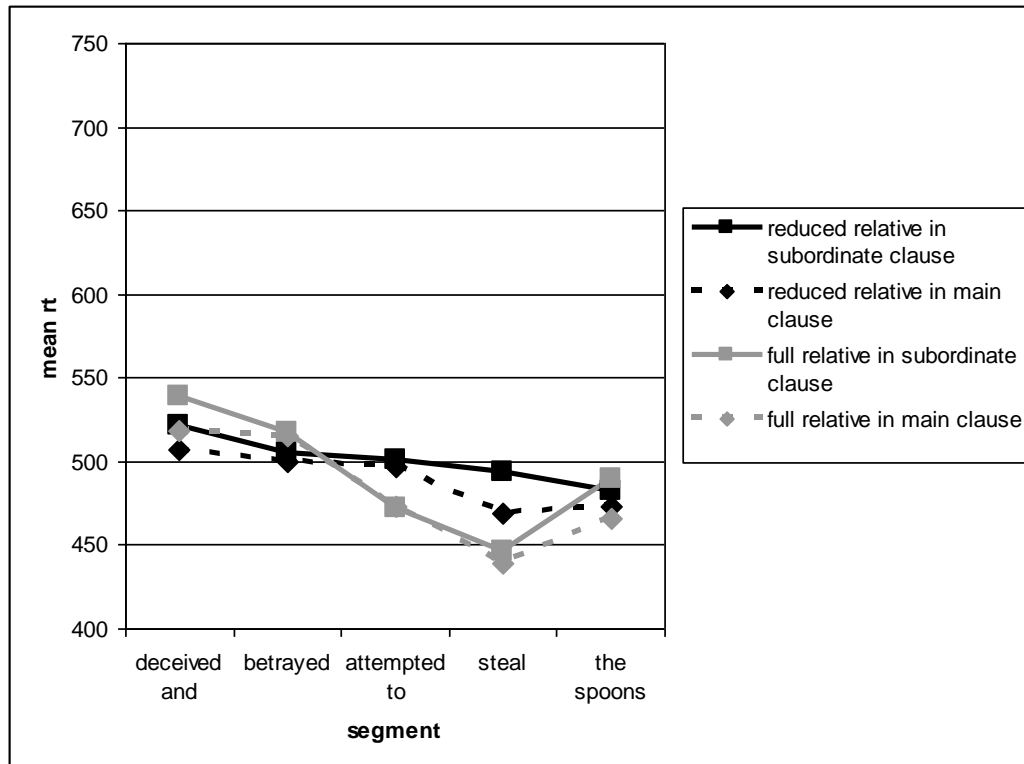


Figure 6: Mean Reading Times by segments for native speakers of English in Experiment 2.

Table 2
Experiment 2: Means

Condition	Segment				
	deceived and	betrayed	attempted to	steal	the spoons
reduced relative in subordinate clause	521.20	505.23	500.87	494.06	482.42
reduced relative in main clause	507.32	499.85	496.36	468.69	473.26
full relative in subordinate clause	538.85	516.98	472.53	446.08	489.40
full relative in main clause	518.28	515.42	473.01	439.34	466.39

deceived and. The main effect of relative clause was not significant; $F_1(1, 28) = 1.83, p > .1$; $F_2(1, 36) = 2.42, p > .1$. We found a marginally significant effect of sentence beginning; $F_1(1, 28) = 3.73, p < .1$; $F_2(1, 36) = 3.54, p < .1$; with shorter reading times for main clauses than for subordinate clauses. The interaction between the two variables was not significant; $F_1 < 1$; $F_2 < 1$.

betrayed. The *betrayed*-segment showed no main effect of relative clause; $F_1(1, 28) = 1.45, p > .1$; $F_2(1, 36) = 2.82, p > .1$; no main effect of sentence beginning; $F_1 < 1$; $F_2 < 1$; and also no interaction between the two variables; $F_1 < 1$; $F_2 < 1$.

attempted to. Results for this segment showed a significant main effect of relative clause; $F_1(1, 28) = 4.51, p < .05$; $F_2(1, 36) = 7.79, p < .05$; with longer reading times for reduced relative clauses than for full relative clauses. The main effect of sentence beginning was non-significant; $F_1 < 1$; $F_2(1, 36) = 1.07, p > .1$; as was the interaction between relative clause and sentence beginning; $F_1 < 1$; $F_2 < 1$.

steal. In this segment, we found a significant main effect of relative clause; $F_1(1, 28) = 14.21, p < .01$; $F_2(1, 36) = 23.71, p < .001$; with shorter reading times for full relative clauses than for reduced relative clauses. The effect of sentence beginning was significant by subjects, but only marginally significant by items; $F_1(1, 28) = 6.19, p < .05$; $F_2(1, 36) = 3.50, < .1$; with shorter reading times for main clauses than for subordinate clauses. The

interaction between relative clause and sentence beginning was non-significant $F_1(1, 28) = 2.09, p > .1; F_2 < 1$.

the spoons. For this segment, results showed no main effect of relative clause; $F_1 < 1; F_2 < 1$, but a significant main effect of sentence beginning; $F_1(1, 28) = 4.53, p < .05; F_2(1, 36) = 5.61, p < .05$; with shorter reading times for main clauses than for subordinate clauses. The interaction between relative clause and sentence beginning was non-significant; $F_1 < 1; F_2(1, 36) = 1.29, p > .1$.

Combined Analysis. To check whether the interaction between relative clause and sentence beginning which occurred in Experiment 1 can really be interpreted as an effect of L1 influence, we conducted a combined ANOVA with data from Experiments 1 and 2, with the native language of the participants as an additional between-subjects variable, for the segment in which the interaction had occurred in Experiment 1 (*betrayed*). Results showed a significant 3-way interaction type of relative clause (reduced vs. full) x type of sentence beginning (subordinate clause vs. main clause) x native language (German vs. English); $F_1(1, 62) = 4.89, p < .05; F_2(1, 36) = 5.74, p < .05$.

Preliminary Summary and Discussion.

As far as the main effects of type of subordinate clause are concerned, results roughly resemble the data pattern from the German sample, for which we also found a significant main effect of type of subordinate clause at *steal*. In this respect, both native and non-native syntactic processing profits from the

inclusion of a *who* to introduce the relative clause. This suggests that native and non-native sentence process at least some syntactic properties in a similar way.

The native sample showed significant main effects of sentence beginning at *steal*, at *the spoons*, and a marginally significant effect at *deceived and*. In all cases, subordinate clauses were harder to process than main clauses, suggesting that the additional level of embedding in subordinate clauses caused difficulty.

Most importantly, however, and unlike the German sample from Experiment 1, the native group showed no interaction between relative clause and sentence beginning at *betrayed*, or in any other segment of the sentence. The significant 3-way interaction relative clause x sentence beginning x native language is a strong indication that native speakers of German parsed this segment in a qualitatively different way than native speakers of English.

However, in order to be able to conclude that the cause of this interaction is really the fact that the sentences in the subordinate/reduced relative condition resemble a German syntactic structure, one alternative explanation has to be ruled out: It is possible that all non-native speakers, rather than only native speakers of German, show such an interaction. If this were the case, it would suggest that the effect is actually not caused by the fact that the sentences resemble a German word order, but by another property of these sentences, which generally increases difficulty for non-native readers. In order to rule out this possibility, it is necessary to replicate the study with a sample of native speakers of a language in which sentences

in the subordinate/reduced relative condition do not resemble a word order from their L1.

Experiment 3

Experiment 3 replicated Experiments 1 and 2, this time with a sample of native speakers of French. Unlike German, French is not verb-final in subordinate clauses. Instead, word order in French subordinate clauses does not differ from word order in French main clauses. Thus, the word order in the subordinate/reduced relative condition does not resemble a syntactic structure from L1 French. If the interaction found in Experiment 1 is caused by L1 influence, the effect should not occur for native speakers of French. If, however, the French sample also shows such an interaction, the effect cannot be the result of an influence of the L1, but must be caused by a kind of general difficulty that all L2 readers, irrespective of their L1 background, experience.

Method

Participants. 32 native speakers of French living in the Dundee area were recruited. All of them had originally learned English at school for at least 9 years. None of the subjects reported advanced knowledge of German. None of the subjects reported advanced knowledge of another foreign language except English.

Items. The same experimental items as in Experiments 1 and 2 were used.

Design. In order to be able to compare the results with the ones from the German sample, it was necessary to create a code-switching situation identical to the one used in Experiment 1. In order to achieve this, all German filler items were translated into French by a trained native speaker of French. In the four lists, these French filler items occurred in the same positions in which their German translation equivalents had occurred in Experiment 1. Thus, the French participants, just like the German sample in Experiment 1, also had to switch between English and their L1 during the Experiment.

Procedure. Participants were tested in the same laboratory we had used for Experiments 1 and 2. They completed the two proficiency tests and the actual experiment in the same order as the German and English samples.

Instruction. Instructions were identical to the ones given in Experiments 1 and 2. Instructions were given orally in English.

Results

Proficiency. Proficiency test results for the Oxford Placement Test and the Meara-Test are shown in Figures 7 and 8, along with the results from the German sample in Experiment 1. To check in how far the French sample differs from the German sample in Experiment 1 in terms of proficiency, independent-samples t-tests were conducted. Results showed no significant proficiency differences between the French sample and the German sample

from Experiment 1, neither for the OPC, $t(62) = 1.32$, $p > .1$, nor for the Meara test, $t(62) = 1.11$, $p > .1$.

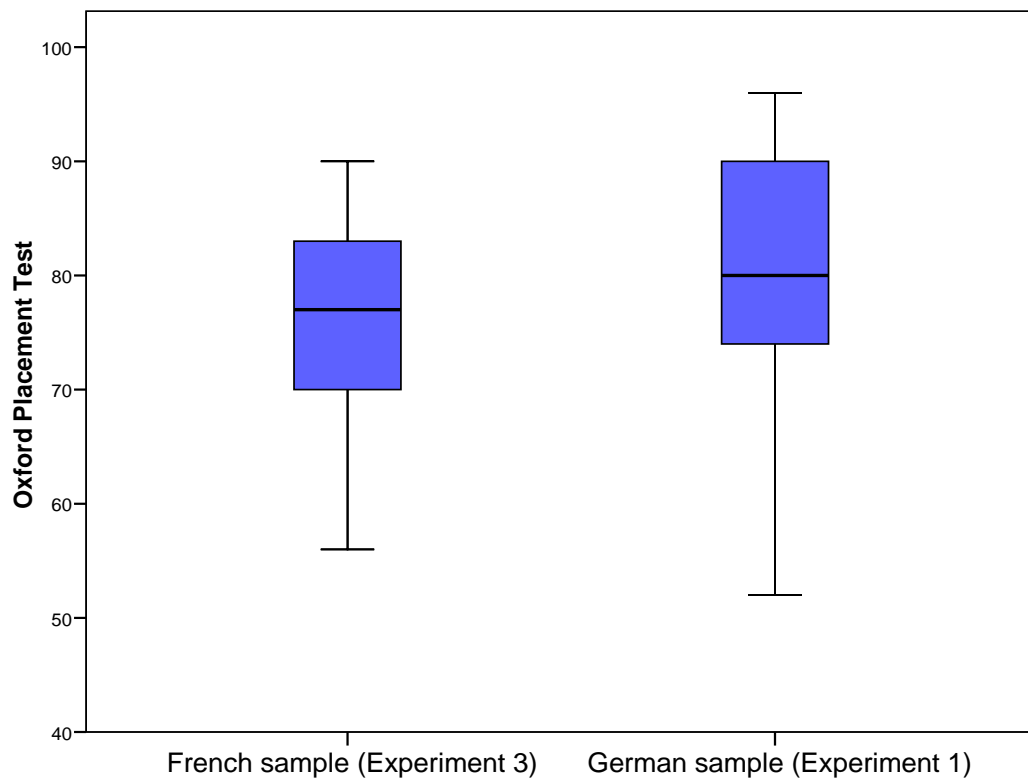


Figure 7: OPC proficiency scores for French participants in Experiment 3

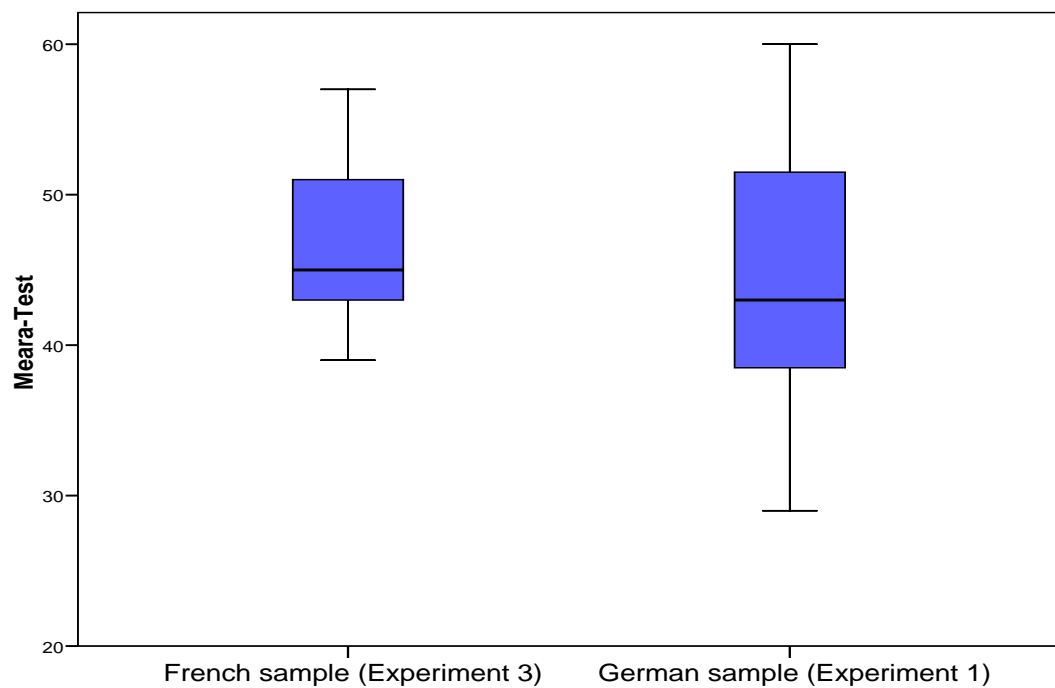


Figure 8: Meara proficiency scores for French participants in Experiment 3

Reading times. We excluded reading times below 150 and above 2500 ms.

Reading times for the French sample are shown in Figure 9, with exact values for all means shown in Table 3. For each segment, we conducted two 2 (type of relative clause) x 2 (type of sentence beginning) x 4 (list) ANOVAs, one by subjects, the other by items. Again, effects involving the factor list are not reported.

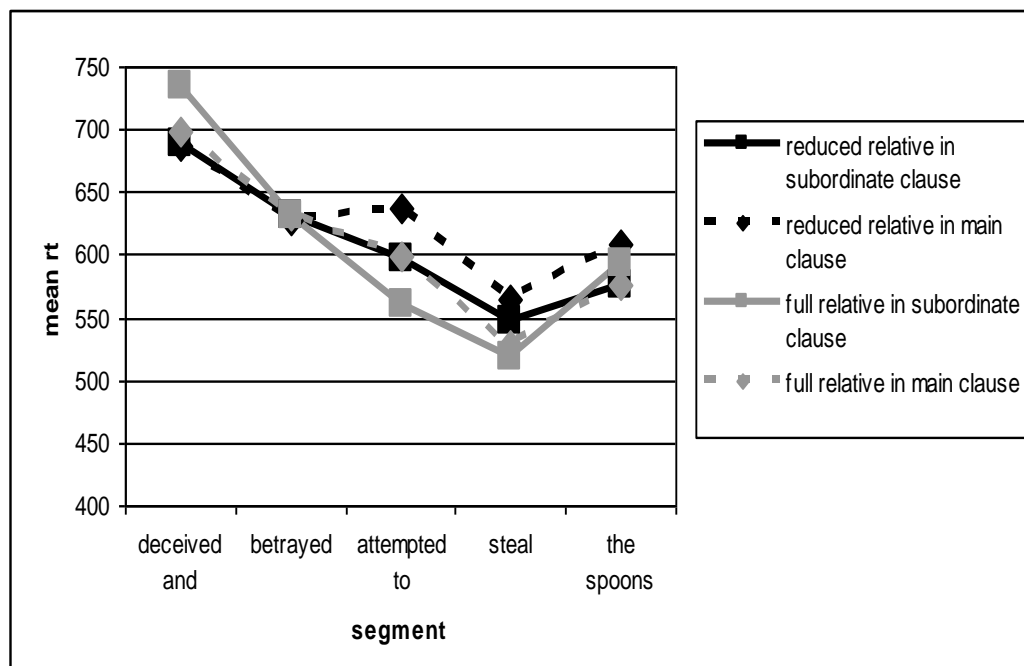


Figure 9: Mean reading times by segments for native speakers of French in Experiment 3

Table 3

Experiment 3: Means

Condition	Segment				
	deceived and	betrayed	attempted to	steal	the spoons
reduced relative in subordinate clause	688.22	631.34	597.80	547.20	576.77
reduced relative in main clause	687.46	628.08	637.98	564.01	608.06
full relative in subordinate clause	734.96	631.59	560.19	518.41	592.90
full relative in main clause	698.19	631.47	599.85	528.27	576.15

deceived and. The main effect of relative clause was non-significant by subjects, but marginally significant by items; $F_1(1, 28) = 2.19, p > .1$; $F_2(1, 36) = 3.85, p < .1$; with longer reading times for full relative clauses as opposed to reduced relative clauses. The main effect of sentence beginning was non-significant; $F_1(1, 28) = 1.05, p > .1$; $F_2(1, 36) = 2.81, p > .1$; as was the interaction between the two variables; $F_1(1, 28) = 1.48, p > .1$; $F_2 < 1$.

betrayed. No effects were found at *betrayed*. The main effect of relative clause; $F_1 < 1$; $F_2 < 1$; the main effect of sentence beginning; $F_1 < 1$; $F_2 < 1$; and the interaction between relative clause and sentence beginning; $F_1 < 1$; $F_2 < 1$; were all non-significant.

attempted to. The ANOVAs for the *attempted to*- segment showed a significant main effect of relative clause; $F_1(1, 28) = 6.56, p < .05$; $F_2(1, 36) = 4.80, p < .05$, with longer reading times for reduced than for full relative clauses. The main effect of sentence beginning was also significant; $F_1(1, 28) = 4.51, p < .05$; $F_2(1, 36) = 5.79, p < .05$; with longer reading times for main clauses than for subordinate clauses. The interaction between the two variables was non-significant; $F_1 < 1$; $F_2 < 1$.

steal. Results showed a significant main effect of relative clause; $F_1(1, 28) = 6.97, p < .05$; $F_2(1, 36) = 5.26, p < .05$; again with shorter reading times for full relative clauses than for reduced relative clauses. The main effect of sentence beginning was non-significant; $F_1(1, 28) = 1.83, p > .1$; $F_2(1, 36) =$

1.31; $p > .1$; as was the interaction between relative clause and sentence beginning; $F1 < 1$; $F2 < 1$.

the spoons. Both the main effect of relative clause; $F1 < 1$; $F2 < 1$; and the main effect of sentence beginning; $F1 < 1$; $F2 < 1$; were non-significant at *the spoons*. The interaction between the two variables was also non-significant; $F1 < 1$; $F2 < 1$.

Combined Analysis. Just as for Experiment 2 above, we conducted a combined analysis, comparing the results from Experiments 1 and 3, for the segment in which the interaction had occurred in Experiment 1 (*betrayed*). The ANOVA showed a marginally significant 3-way-interaction native language (German vs. French) x relative clause (reduced vs. full) x sentence beginning (subordinate vs. main), $F1 (1, 62) = 3.27$, $p < .1$; $F2 (1, 39) = 2.94$, $p < .1$.

Preliminary Summary and Discussion

Just like in Experiments 1 and 2, we observed main effects of type of subordinate clause (full vs. reduced) for the French sample, with the respective segments being easier to process when the sentence contained a *who* to introduce the relative clause. The fact that we found such main effects in all 3 experiments, irrespective of native language status of the participants, suggests that all three groups made use of the additional information conveyed by the inclusion of *who* in a similar way. This is a strong indication that at least some parsing strategies, specifically the way a parser makes use

of syntactic information conveyed by an optional function word such as *who*, are universal in the sense that they are used by both native and non-native readers.

Note that in all 3 experiments, the main effects of relative clause occurred relatively late in the sentence, after the relative clause had already been processed. I argue that including a *who* to introduce the relative clause does not facilitate the processing of this relative clause itself, but clarifies how many levels of embedding the sentence contains, thus making it easier for the parser to decide how to include subsequent material. I get back to the issue of the main effects of type of relative clause below, in the chapter discussion.

The French sample also showed a significant main effect of sentence beginning at *attempted to*, with significantly longer reading times for main clauses than for subordinate clauses. It is possible that this is a strategic effect in the sense that readers spent more time on main clauses than on subordinate clauses because they considered the main clause to be the most important part of the sentence.

Most importantly, we found no interaction between relative clause and sentence beginning in any segment. In this respect, the French data pattern resembles the results from the native English sample, but differs from the German results. If the interaction found at *betrayed* in Experiment 1 reflected a general type of difficulty which all non-native speakers of English experience, then the French sample should have shown the interaction as well. Note that this difference between the German and French data patterns can also not be explained in terms of differences in L2 proficiency, because

neither the lexical nor the syntactic proficiency tests showed a significant proficiency difference between the German and French groups. Note also that while the difference between the German sample and the native English sample could theoretically also be explained by the fact that the German group was put in a code-switching situation, while the native English group was not, the difference between the German and French data patterns cannot be explained in this way, because the French group also experienced a code-switching situation. In sum, I argue that this is a strong indication that the interaction found for the German sample in Experiment 1 really reflects an influence of the L1 on L2 syntactic processing.

While the difference between the German and French data patterns cannot be explained in terms of code-switching, it is still possible that the presence of German filler sentences facilitated the influence of the L1. It is reasonable to assume that an influence of the L1 is more likely to occur in a situation in which the individual has to keep both the L1 and the L2 linguistic systems active. In a purely monolingual situation, in which the speaker can be sure that he will not encounter any L1 sentences in the near future, such an influence of the L1 might be considerably smaller, or might disappear entirely. In order to investigate in how far the L1 influence depends on the presence of a code-switching situation, it is necessary to replicate the experiment with a sample of native speakers of German who are not in a code-switching situation while processing the experimental sentences.

Experiment 4

Experiment 4 is a replication of Experiment 1, the only difference being that the code-switching situation was removed. Thus, participants could be certain that they would only have to deal with English sentences during the entire experiment.

Method

Participants. We recruited a second sample of 32 native speakers of German living in the Dundee area. None of the subjects had participated in Experiment 1.

Items. All experimental items were identical to the ones used in Experiment 1.

Design. In order to remove the code-switching situation, all German filler sentences were translated into English. All translations were checked by two native speakers of English. In the 4 lists, the translated sentences occurred in the same positions in which their German translation equivalents had occurred in Experiment 1.

Procedure. Participants were tested in the same laboratory, and using the same equipment, as the participants in Experiment 1. All subjects went through the various stages of data collection (the two English proficiency

tests and the actual experiment) in the same order as participants in Experiment 1.

Instruction. Instructions were identical to the ones given in Experiment 1, except for the fact that the subjects were told that all sentences they would encounter during the experiment were English. Instructions were again given orally in English.

Results

Proficiency. OPC and Meara scores for the sample in Experiment 4 are shown in Figures 10 and 11.

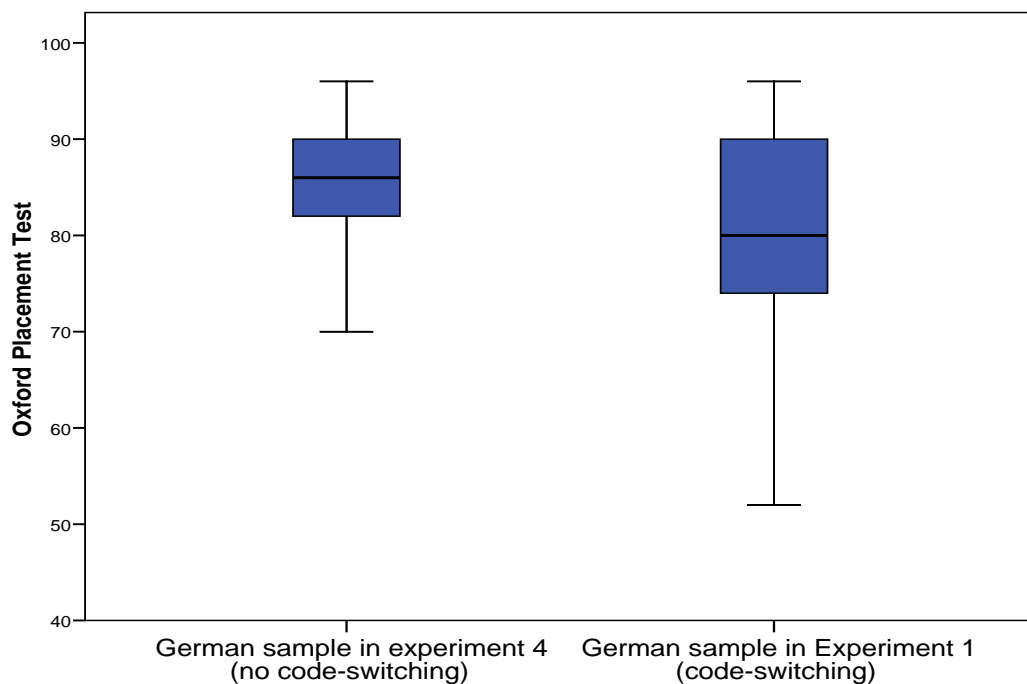


Figure 10: OPC proficiency scores for the German sample in Experiment 4

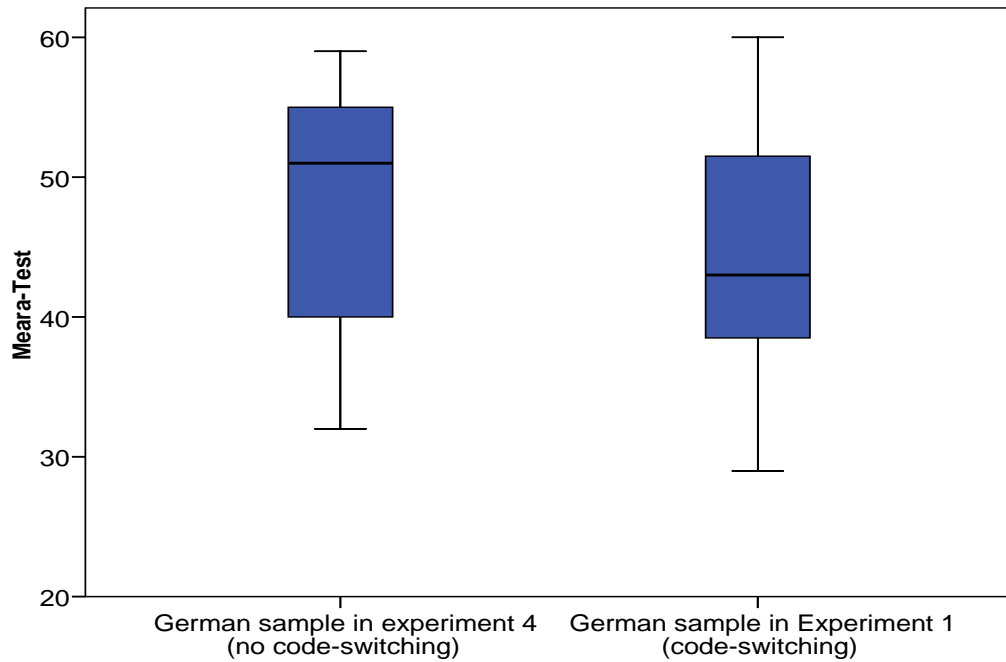


Figure 11: Meara proficiency scores for the German sample in Experiment 4

Just as in Experiment 3 above, in order to be able to compare reading time results from the sample in Experiment 4 with results from Experiment 1, it is important that the two samples do not differ in terms of proficiency; otherwise, effects in the reading time data could be explained in terms of a proficiency difference between the two samples. Independent-samples t-tests show no significant difference between the two samples, neither for the OPC, $t(62) = 1.32, p > .1$, nor for the Meara test, $t(62) = .94, p > .1$.

Reading Times. Mean reading times by segments are shown in Figure 12, with exact values shown in Table 4. Just as in Experiments 1-3, we excluded reading times below 150 ms and above 2500 ms.

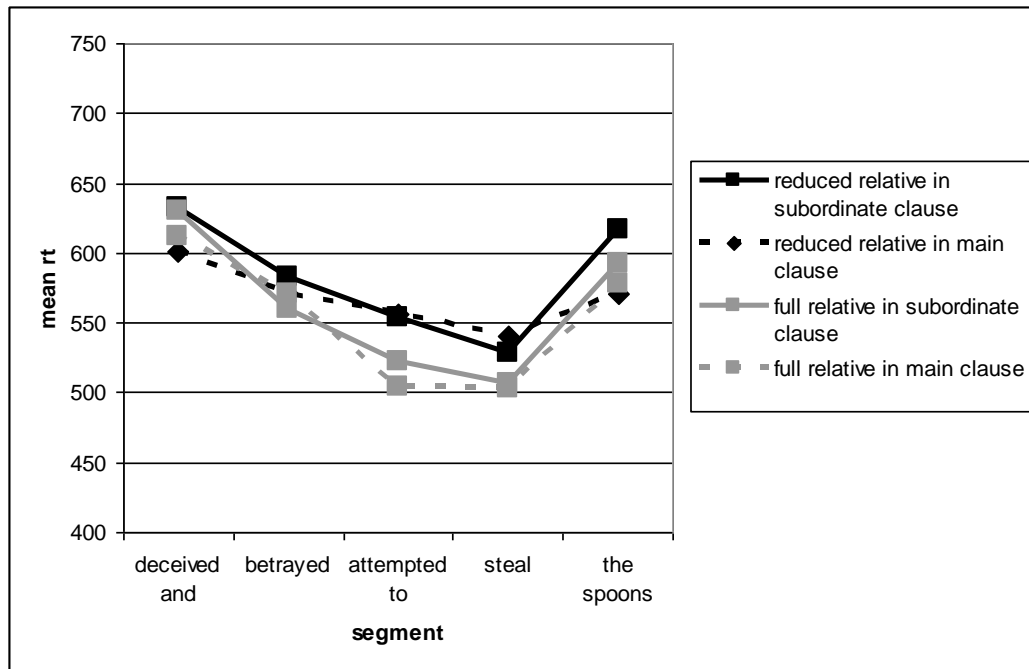


Figure 12: Mean Reading times by segments for native speakers of German in Experiment 4.

Table 4
Experiment 4: Means

Condition	Segment				
	deceived and	betrayed	attempted to	steal	the spoons
reduced relative in subordinate clause	632.42	582.65	554.07	528.33	617.35
reduced relative in main clause	600.47	571.30	555.75	539.97	571.23
full relative in subordinate clause	630.68	559.77	522.85	506.82	592.20
full relative in main clause	611.92	570.63	504.71	502.81	578.59

deceived and. The main effect of relative clause was non-significant at this segment; $F_1 < 1$; $F_2 < 1$; as was the main effect of sentence beginning; $F_1 (1, 28) = 1.79$, $p > .1$; $F_2 (1, 36) = 2.03$, $p > .1$. The interaction between relative clause and sentence beginning was also non-significant; $F_1 < 1$; $F_2 < 1$.

betrayed. Just as for *deceived and*, we found no main effect of relative clause; $F_1(1, 28) = 1.48, p > .1$; $F_2 < 1$; no main effect of sentence beginning; $F_1 < 1$; $F_2 < 1$; and no interaction between the two variables; $F_1(1, 28) = 2.06, p > .1$; $F_2(1, 36) = 1.31, p > .1$.

attempted to. Results for the *attempted to*-segment showed a significant main effect of relative clause; $F_1(1, 28) = 5.84, p < .05$; $F_2(1, 36) = 9.30, p < .01$, with shorter reading times for sentences with full relative clauses than for sentence with reduced relative clauses. The main effect of sentence beginning was non-significant; $F_1 < 1$; $F_2 < 1$; as was the interaction between relative clause and sentence beginning; $F_1(1, 28) = 2.06, p > .1$; $F_2(1, 36) = 1.31, p > .1$.

steal. At *steal*, we found a significant main effect of relative clause, $F_1(1, 28) = 6.85, p < .05$; $F_2(1, 36) = 6.36, p < .05$; with shorter reading times for sentences with a full relative clause than for sentences with a reduced relative clause. Results at *steal* showed no main effect of sentence beginning; $F_1(1, 28) = 1.71, p > .1$; $F_2(1, 36) = 1.41, p > .1$ and no interaction between relative clause and sentence beginning; $F_1(1, 28) = 1.02, p > .1$; $F_2(1, 36) = 1.46, p > .1$.

the spoons. We found no main effect of relative clause at *the spoons*; $F_1 < 1$; $F_2 < 1$. The main effect of sentence beginning was non-significant by subjects, but marginally significant by items; $F_1(1, 28) = 2.04, p > .1$; $F_2(1, 36) = 3.06, p < .1$; with sentences starting with a subordinate clause showing

longer reading times than sentences starting with a main clause. The interaction between the two variables was non-significant; $F_1 < 1$; $F_2(1, 36) = 1.09$, $p > .1$.

Combined Analysis. To determine whether code-switching affected the effect of L1 influence found in Experiment 1, we conducted a combined analysis comprising the data sets from both Experiments 1 and 4, for the *betrayed*-segment. Specifically, if the presence of a code-switching situation enhances the effect of L1 influence found in the *betrayed*-segment in Experiment 1, a 2 (Switching vs. no Switching) x 2 (reduced vs. full relative clause) x 2 (subordinate clause vs. main clause) ANOVA should show a significant 3-way-interaction relative clause (reduced vs. full) x sentence beginning (subordinate clause vs. main clause) x code switching (present vs. absent).

The 2x2x2 ANOVA showed a significant main effect of switching vs. no switching, $F_1(1, 62) = 6.63$, $p < .05$, $F_2(1, 39) = 109.60$, $p < .001$, with longer reading times for switching than for non-switching. The segment also showed a 2-way interaction relative clause x sentence beginning, $F_1(1, 62) = 5.65$, $p < .05$; $F_2(1, 39) = 4.30$, $p < .05$. However, the 3-way-interaction code-switching x relative clause x sentence beginning was not significant; $F_1(1, 62) = 1.78$, $p > .1$; $F_2(1, 39) = 1.34$, $p > .1$.

Preliminary summary and discussion

As far as the main effects of type of subordinate clause are concerned, the findings match the data patterns from the previous experiments: The presence

of a *who* which introduced the relative clause made processing of subsequent segments of the sentence easier.

As in Experiment 1, the German sample in Experiment 4 also showed no significant main effects of sentence beginning in any segment.

Regarding a possible influence of the L1, although the data pattern found at *betrayed* in Experiment 4 was numerically similar to the one found in Experiment 1, the interaction type of relative clause x type of sentence beginning was no longer significant. While this is consistent with the possibility that the presence of a code-switching situation enhances the influence of the L1 on L2 syntactic processing, the combined analysis did not reveal a significant 3-way-interaction at *betrayed*. As a result, it is not possible to decide in how far code-switching really affected the influence of the L1. At least, however, the combined analysis showed a significant main effect of code-switching, suggesting that L2 sentence processing was affected by the presence or absence of a code-switching situation.

Furthermore, the fact that the combined analysis of the two data sets also showed a significant 2-way-interaction between relative clause and sentence beginning can be considered further support for the presence of an influence of the L1.

Chapter Summary

The Chapter contained four experiments investigating how L2 speakers and native speakers processed sentences with a word-order which resembles a word order from a particular L1.

All four experiments show significant main effects of type of subordinate clause (reduced vs. full). Both the native group and all L2 groups, irrespective of their L1 background, found the sentences easier to process when the relative clause was introduced by a *who*. In all experiments, these main effects occurred relatively late in the sentence, such as at *attempted to* or at *steal*. This makes sense, given that the *who* clarifies how many levels of embedding the sentence contains, which presumably makes it easier to integrate subsequent constituents. In other words, if the sentence contains a *who* to introduce the relative clause, it is easier to decide which level of embedding a new constituent belongs to.

The fact that main effects relative clause occur in all four experiments, and always in approximately the same area of the sentence, suggests that L1 and L2 processing are at least partly based on the same principles: The data patterns suggest that L1 and L2 speakers make use of the additional information that the *who* contains in similar ways. I return to this issue in Chapter 8, below.

In contrast to the main effects of relative clause, the data patterns for the main effects of sentence beginning differ across experiments, with the native English sample in Experiment 2 showing longer reading times for subordinate clauses than for main clauses in several segments, while the German and French samples in Experiments 1 and 3 did not show such effects⁶. It is possible that native speakers are more sensitive to the differences between main clauses and subordinate clauses than non-native speakers. For example, native speakers might compute the additional level of

⁶ With the one exception of a significant main effect of sentence beginning for the French sample at *attempted to*, which goes in the other direction than the effect for the English sample. We interpreted this as a strategic effect, see the discussion section for Experiment 3.

embedding in subordinate clauses already while they are processing the subordinate clause, while non-native speakers might process syntactic information more locally, concentrating on the clause they currently process.

Most importantly, with regard to an influence of the native language, results from Experiment 1 showed a significant interaction between relative clause and sentence beginning in the *betrayed* segment. This effect does not occur for the native English and French samples in Experiments 2 and 3. Combined analyses deliver further support for the claim that in the *betrayed* segment, the data pattern for the German sample is qualitatively different from the data patterns of the English and French samples. In sum, this suggests that the native speakers of German in Experiment 1 activated a syntactic structure from their L1 while processing English sentences.

CHAPTER 7

Experiments 5-7: Shallow Processing and L1 Influence in the Processing of Word-Order Violations

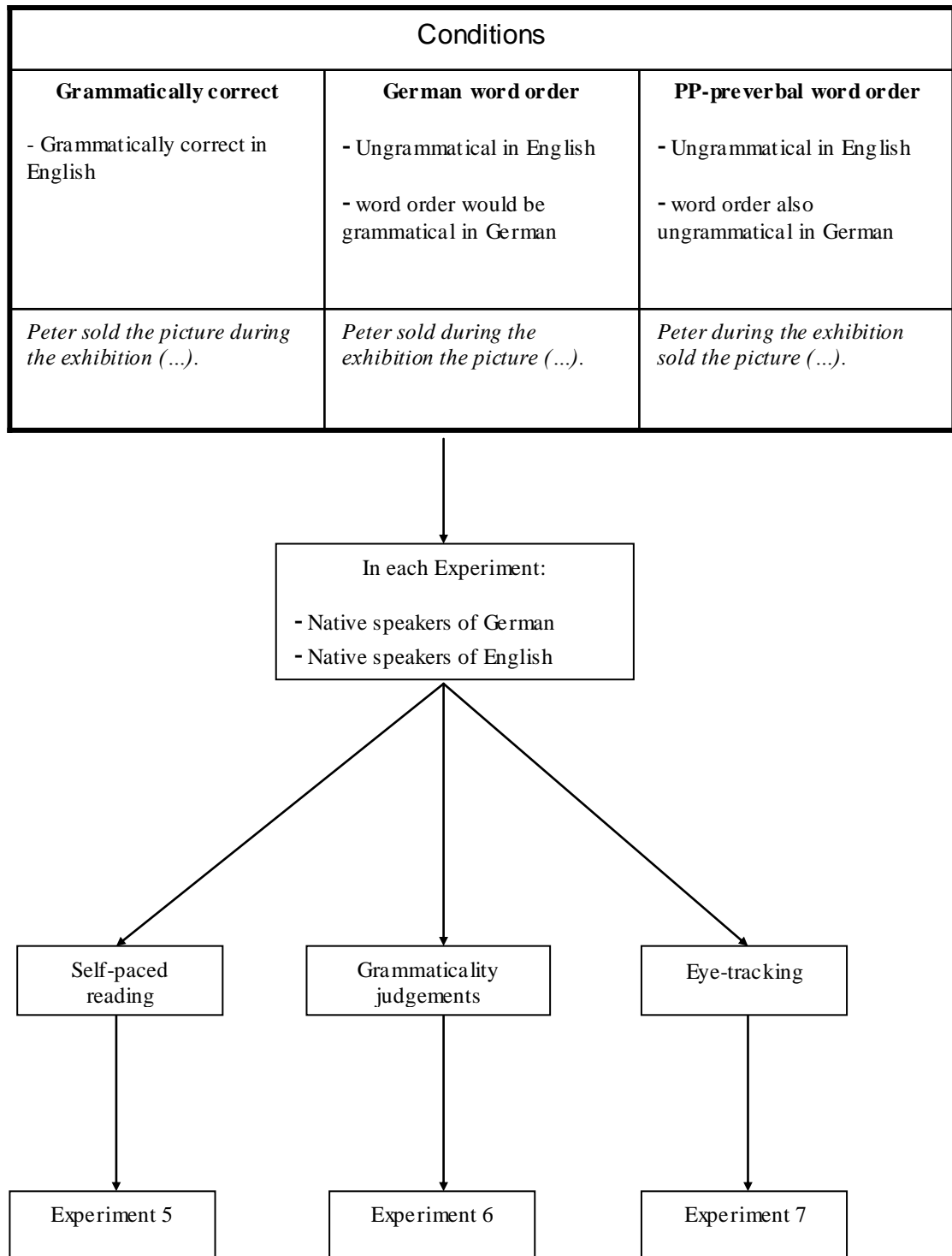


Figure 13. Plan of Experiments in Chapter 7.

The 4 experiments presented in Chapter 6 investigated the role of the L1 in L2 syntactic processing. In the current models of L2 syntactic processing, however, the issue of a possible L1 influence is normally not discussed in isolation, but in conjunction with other claims about mechanisms involved in L2 processing: In Clahsen & Felser's (2006) Shallow-Structure Account, the prediction that properties of the L1 should have no influence on L2 syntactic processing is derived from the claim that L2 readers compute only a very shallow representation of the syntactic structure of an L2 sentence. In this respect, the issue of L1 influence is automatically linked to questions of shallow processing. The studies presented below represent an attempt to address both questions of L1 influence and questions of shallow processing within the same experimental framework.

One possibility to investigate both L1 influence and shallow processing within the same experiment is the study of word-order violations. Consider the following example sentences (30a), (30b), and (30c):

(30a) David baked the rolls during the break.

(30b) *David baked during the break the rolls.

(30c) *David during the break baked the rolls.

All 3 versions of the sentence contain a subject, a verb, a direct object, and a temporal phrase. What makes sentences (30b) and (30c) ungrammatical is the position of the temporal phrase *during the break*. In English, this temporal phrase can neither occur between the verb and the direct object (as in sentence

(30b)), nor between the subject and the verb (as in sentence (30c)). In German, however, this is different. Consider the German word-by-word translation equivalents of the above example sentences:

(31a) David backte die Brötchen während der Pause.

(31b) David backte während der Pause die Brötchen.

(31c) *David während der Pause backte die Brötchen.

German resembles English regarding the fact that the temporal phrase *während der Pause* cannot occur between the subject and the verb. As a result, the word order in sentences (30c) and (31c) is ungrammatical in both English and German. However, German allows for a temporal phrase to occur between the verb (*backte*) and the direct object (*die Brötchen*). Therefore, the word order in sentences (30b) and (31b) is ungrammatical in English, but grammatically correct in German. If L2 syntactic processing is influenced by grammatical properties of the L1, native speakers of German should find it easier to deal with the grammatical violation in sentence (30b) than with the grammatical violation in (30c), because the word order in (30b), while ungrammatical in English, is grammatical in German. In other words, the fact that the parser knows the particular word order in sentence (30b) from the L1 should make it easier to overcome the problem of parsing an ungrammatical word order. Thus, an account assuming that L1 properties influence L2 parsing would predict that a native speaker of German finds sentence (30a), which is grammatically correct in both languages, easiest to process, followed by sentence (30b), which is ungrammatical in English, but at least

grammatical in the L1. Sentence (30c) would then be more difficult to process than both (30a) and (30b), because its word order is ungrammatical in both the L2 and the L1.

An account assuming that L2 speakers process syntactic information shallowly would predict a different data pattern. If an L2 speaker's representation of the syntactic structure of the sentence is too shallow to be influenced by syntactic properties of the L1, it should not matter whether an ungrammatical word order is grammatical in the L1. As a result, sentences (30b) and (30c) should be equally difficult to process, because both are ungrammatical. Furthermore, if an L2 reader's syntactic representation is shallower, the parser should be less effected by whether a particular word order is grammatical or not: If syntax in general is only processed in a rudimentary way, it should not matter so much whether the sentence contains a syntactic violation. Therefore, the difference in processing difficulty between the grammatical sentence (30a) and the two ungrammatical sentences (30b) and (30c) should be smaller than for native speakers.

One particular advantage of studying L1 influence and shallow processing within the context of a single experiment deserves to be pointed out here: In experiments investigating effects of L1 influence in isolation, the shallow-structure account would predict that no L1 influence occurs; in other words, the account would predict a null effect. Statistical null effects, however, cannot be interpreted, so even if the predicted null effect emerges, this cannot be considered support for the shallow-structure hypothesis. In the above case of word-order violations, however, it is possible to derive specific predictions from the shallow-structure account; rather than a null effect, the

account would actually predict a specific pattern of differences in processing difficulty between the three conditions. This allows us to use word order violations such as (30) above as a real test of the shallow-structure account.

Previous studies testing predictions of the Competition Model and the Shallow-Structure Account are relatively difficult to compare, primarily because both traditions have relied on different methodological tools: While previous research on the Competition Model is mainly based on off-line methods, most notably the Sentence-Interpretation Paradigm described in Chapter 2, research on the Shallow-Structure account has mainly relied on on-line measures, such as self-paced reading or ERP measures. It is reasonable to assume that a different methodological approach might result in a different pattern of results. Therefore, in order to be able to systematically compare the two accounts, it is useful to make use of both on-line and off-line methods, and to systematically compare the respective data patterns.

The studies presented in this chapter investigate how native speakers of English and L2 speakers with German as their L1 process word-order violations such as (30) above. Experiment 5 investigates how the 3 versions of sentence 2 are processed in real time, by measuring total-sentence reading times (an on-line approach). Experiment 6 deals with the question in how far the different word order in sentences such as (30a), (30b), and (30c) influences grammaticality judgements of native and L2 speakers (an off-line approach). Finally, Experiment 7 measures eye-movements during processing of such sentences.

Experiment 5

Experiment 5 investigated how L2 speakers of English with German as their L1, and a control group of native English speakers, processed sentences such as (30a), (30b), and (30c) above, in real time.

Method

Participants. We recruited a sample of 18 native speakers of German and a control sample of 18 native English speakers living in the Dundee area. None of the 36 participants was dyslexic, and all had normal or corrected-to-normal vision.

All participants in the German group had originally learned English as a foreign language at school for at least 9 years, and had later moved to Scotland. At the time of testing, all participants had already been living in an English-speaking environment for at least a year.

All participants in the English control group were monolingual native speakers of English. None of the participants reported any advanced knowledge German, or any other foreign language.

Items. 30 item sets were created. All sentences consisted of a subject, a verb, a direct object, and a temporal phrase. The word order in all sets resembled the word order shown in example sentences (30a), (30b), and (30c) above. As spill-over effects are common in reading time measures, we added a spill-over segment to all experimental sentences. An example is shown in sentence (31):

(31a) Christine checked the article after the meeting/ but overlooked some mistakes.

(word order grammatical in both English and German)

(31b) Christine checked after the meeting the article/ but overlooked some mistakes.

(word order ungrammatical in English, but word order of the German word-by-word translation is grammatical).

(31c) Christine after the meeting checked the article/ but overlooked some mistakes.

(word order ungrammatical in both English and German)

The spill-over segments were introduced with *but*, *when*, *while*, or *because*, followed by a variety of different syntactic structures. In all sentences, the subject was a proper name; this avoided the possibility of attaching the temporal phrase to the subject in condition (31c) (e.g. *the technician after the meeting* as opposed to another technician before the meeting).

For all sentences in condition (31a), it was taken care that a direct word-by-word translation of the entire sentence, including the spill-over segment, into German resulted in a grammatically correct German sentence, with the same meaning as the English translation equivalent. For all sentences in condition (31b), the result of a word-by word translation into German was always also a grammatically correct German sentence, despite the fact that the word order in (31b) is ungrammatical in English. For all sentences in condition (31c), however, a word-by-word translation of the sentence into

German always resulted in a German sentence with an ungrammatical word order.

Design. We created three lists, each comprising ten items from each condition, with each list containing exactly one of the three versions of each item. We added a total of 60 English filler sentences. All fillers were of similar length as the experimental sentences. As all experimental sentences consisted of an experimental segment (e.g. *Christine checked the article after the meeting*) and a spill-over segment (e.g. *but overlooked some mistakes.*), all fillers were divided into two segments as well.

To be able to check whether participants really processed the sentences, a third of all experimental sentences and a third of all fillers were followed by comprehension statements. For each comprehension statement, participants had to judge whether what was said in the statement was correct or not when compared with the meaning of the previous sentence. For half of all comprehension statements, the correct response was “yes”, for the other half, it was “no”. Participants responded to the statements by pressing a “yes”- or a “no”- button.

Procedure. Before the experiment, all participants completed part 1 of the Grammar section of the Oxford Placement Test; then the actual Experiment started.

Sentences were presented on a 17-inch monitor, using the DMDX software. Participants started each trial by pressing a button on a button box in front of the screen. The button press caused the first segment of a sentence

(e.g. *Christine checked the article after the meeting*) to appear on screen.

Participants read the segment silently, and proceeded by pressing the button for a second time. The first segment of the sentence disappeared, and the second segment (e.g. *but overlooked some mistakes.*) was shown, on the right-hand-side of the position where the first segment had been shown before.

Participants read the second segment silently, and finished the trial by pressing the button for a third time. If a comprehension statement appeared, participants gave an answer to the statement by pressing either a “yes”- or a “no”- button on the same button box.

Instruction. Participants were instructed to read all segments silently, and as naturally as possible. Instructions were given orally in English.

Results

Proficiency. OPC scores for the German and English samples are shown in Figure 14, along with scores from a norming sample consisting of 32 native speakers of German living in Germany (the same norming sample as in Experiment 1 above). While scores of the German sample were significantly lower than those of the native sample, $t(34) = 3.88$, $p < .001$, their proficiency was significantly higher than that of the norming sample, $p(48) = 6.27$, $p < .001$.

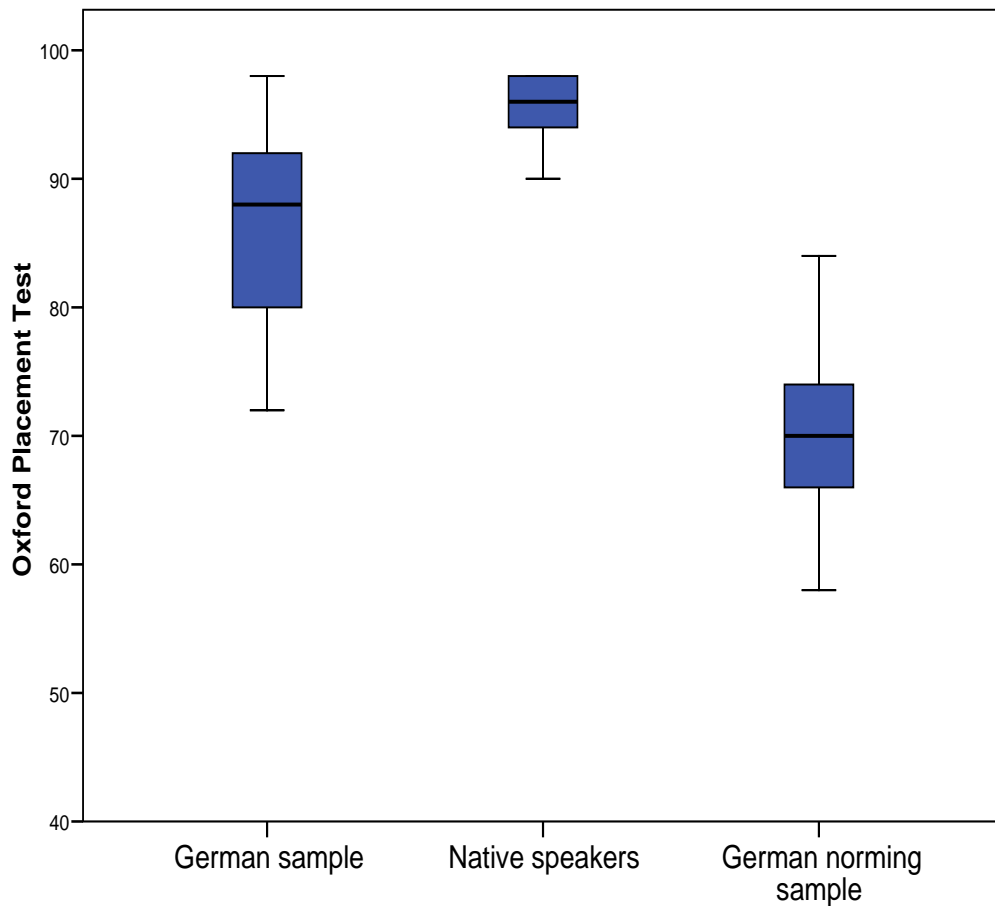


Figure 14: OPC Scores for samples from Experiment 5

Reading times. Mean reading times by condition by native language for the experimental segment are shown in Figure 15, with Table 5 showing the exact means by condition for both the experimental segment and the spill-over segment. For both segments, we conducted two 3 (condition) x 2 (native language) x 3 (list) mixed ANOVAs, one by subjects, the other by items. Subject list/item list was added as a separate factor to account for additional error variance based on list. Effects involving the factor list are not reported.

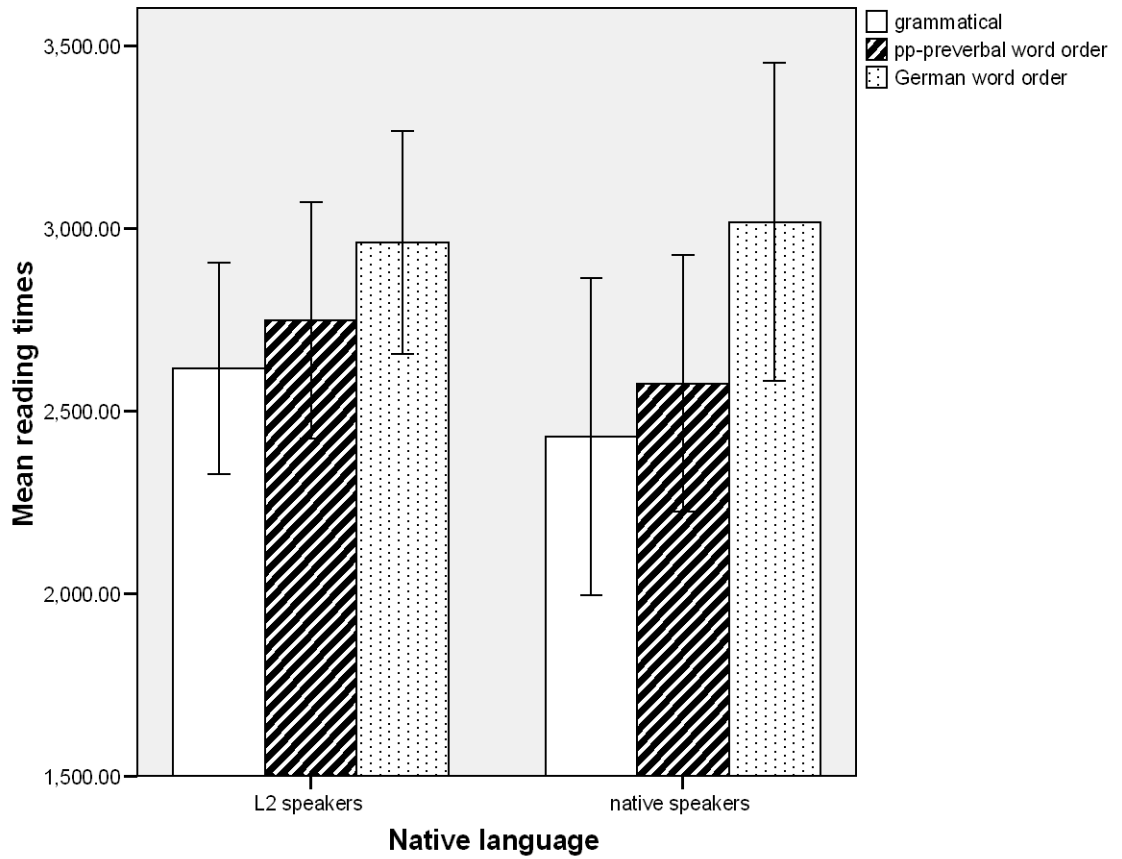


Figure 15: Mean reading times by condition by native language for the experimental segment in Experiment 5. Error bars represent 95% -confidence intervals.

Table 5
Experiment 5: Mean Reading Times

		Segment	
		Experimental	Spill-over
whole sample	grammatically correct	2526.20	1662.98
	pp-preverbal word order	2665.01	1670.31
	German word order	2989.65	1711.60
L2 group	grammatically correct	2617.36	1755.78
	pp-preverbal word order	2749.54	1748.14
	German word order	2962.22	1788.61
native group	grammatically correct	2429.98	1565.02
	pp-preverbal word order	2575.79	1588.17
	German word order	3018.61	1630.32

Results for the spill-over segment showed no main effects or interactions (with $F_s < 1$ for all main effects and interactions).

For the experimental segment, we found a significant main effect of condition; $F_1(2, 60) = 34.64, p < .001$; $F_2(2, 54) = 33.86, p < .001$. Planned comparisons were conducted to compare the grammatically correct word-order with the German word-order, and to compare the pp-preverbal condition with the German word-order. Results showed that reading times for the German word order were significantly slower than for the grammatically correct word order; $F_1(1, 33) = 56.36, p < .001$; $F_2(1, 27) = 26.50, p < .001$. Results also showed a significant difference between German and pp-preverbal word-order; $F_1(1, 33) = 26.51, p < .001$; $F_2(1, 27) = 7.94, p < .01$, with significantly slower reading times for German word order than pp-preverbal word order.

Results revealed no main effects of native language ($F_1 < 1$; $F_2 < 1$).

The interaction between condition and native language was non-significant by subjects, but marginally significant by items; $F_1(2, 60) = 2.11, p > .1$; $F_2(2, 54) = 3.03, p < .1$. To explore this further, we conducted two separate 3 (condition) x 2 (list) ANOVAs, one for each of the two subjects groups (German and native). For the German sample, the ANOVA revealed significant reading-time differences between the 3 conditions; $F_1(2, 30) = 10.78, p < .001$; $F_2(2, 54) = 11.77, p < .001$. Planned comparisons showed that reading times for the German word order were significantly slower than for the grammatically correct word order; $F_1(1, 15) = 21.27, p < .001$; $F_2(1, 27) = 26.50, p < .001$. Planned comparisons also showed that reading times for the German word order were significantly slower than for pp-preverbal word order; $F_1(1, 15) = 5.86, p < .05$; $F_2(1, 27) = 7.94, p < .01$. The ANOVA for the English group also showed significant differences between

the three conditions $F(1, 30) = 25.01, p < .001$; $F(2, 54) = 29.55, p < .001$. Planned comparisons showed significantly longer reading times for the German word order than for the grammatically correct word order; $F(1, 15) = 36.19, p < .001$; $F(1, 27) = 36.09, p < .001$; and also significantly longer reading times for German word order as opposed to pp-preverbal word order; $F(1, 15) = 25.23, p < .001$; $F(1, 27) = 32.28, p < .001$.

Preliminary summary and discussion.

For both native speakers of German and native speakers of English, results showed an effect of grammaticality on reading times: Both subject groups found the German word order significantly harder to process than both the grammatically correct word order and the pp-preverbal word order. These effects can be interpreted as evidence against shallow processing in L2 reading: The three conditions only differ in terms of word order; thus, a difference in reading times between the three conditions can only occur if the parser accessed word order information during processing. As the processing of word order is a part of syntactic processing, participants must have processed the syntactic structure of the sentence.

According to the predictions of the shallow-structure account, the L2 group should not have shown an effect of condition, and should in this respect have differed significantly from the native group. In this respect, results can be considered evidence against the shallow-structure account.

Results can also be considered evidence against an influence of the L1: An effect of L1 influence should have resulted in a significant interaction between condition and native language, but this interaction was non-

significant by subjects, and only marginally significant by items. Also, separate analyses for each of the two subject groups showed a similar data pattern for both groups, with German word order being harder to process than both grammatical and pp-preverbal word order. Finally, if properties of the L1 had influenced processing of the sentences, sentences with a German word order should have been easier to process for native speakers of German than sentences with pp-preverbal word order. Instead, we found the reverse pattern, with the German word order actually being significantly more difficult, rather than easier, to process than the pp-preverbal word order. In this respect, results can be considered evidence against the competition model, which predicted effects of L1 influence. However, with regard to these predictions of the competition model, two important points should be kept in mind: First, while the interaction between condition and native language was not significant by subjects, it was at least marginally significant by items. It is possible that the interaction did not reach significance because a measure such as total-clause reading time was not sensitive enough to capture the effect. Second, previous research on the competition model has mainly focussed on experiments involving off-line measures, such as the sentence-interpretation paradigm described in Chapter 2. As a result, it is difficult to compare this body of research with the experiment described above: Experiments 5, by using reading times as a dependent variable, concentrates on sentence processing in real time, while off-line methods such as the sentence-interpretation paradigm focus on the ultimate outcome of processing.

Experiments 6 and 7 represent an attempt to address these possibilities, by measuring grammaticality judgements (Experiment 6) and eye movements (Experiment 7).

Experiment 6

Experiment 6 is based on the same materials as Experiment 5, but uses off-line grammaticality ratings as a dependent variable. Thus, as already mentioned, while Experiment 5 investigated possible effects of word-order violations in real time, Experiment 6 focuses on the ultimate outcome of processing, by asking participants to judge a particular property of the sentence (in this case, grammaticality) after processing is complete. In this respect, the methodological approach in Experiment 6 is more similar to traditional research on the competition model, such as the studies using the sentence-interpretation paradigm described in Chapter 2, which is also based on participants answering a question about a property of the sentence after processing is complete.

Note that grammaticality, in psycholinguistic terms, is not necessarily a binary variable in the sense that a sentence can only be either grammatical or ungrammatical. Instead, a participant might perceive a difference between two ungrammatical sentences, in the sense that he considers one sentence even more ungrammatical than another. In this respect, grammaticality has to be considered as a continuous variable. This is especially important regarding the particular materials used in Experiment 5: For both the German and the native group, reading times showed a significant difference between German

and pp-preverbal word order, even though both of these conditions were ungrammatical in English. In a binary measure of grammaticality, in which participants are only asked whether a sentence is grammatical or ungrammatical, such a difference between the two conditions would remain undetected, because it is likely that both conditions would be considered ungrammatical. To take this into account, Experiment 7 asks participants to rate the grammaticality of the sentences on a 7-point scale.

Method

Participants. The same 36 participants who had already participated in Experiment 5 took part in the study for additional payment.

Proficiency scores and general characteristics of the sample are reported in Experiment 5, above.

Items. All items were the same as in Experiment 5, except for the fact that the spill-over segments were removed.⁷

Design. The three lists were identical to the lists used in Experiment 5: Each list contained 10 items from each condition, and each of the three versions of each item occurred in exactly one of the three lists. To account for the fact that the spill-over-segments were left out, the English filler sentences from Experiment 5 were also shortened, so that their length matched the length of the experimental materials.

⁷ Note that in Experiment 5, it was necessary to include the spill-over segments to account for possible spill-over effects, which occur relatively often in self-paced-reading studies. In Experiment 6, however, the inclusion of the spill-over segments would have served no purpose, and would have presumably added more noise to the measures.

Procedure. Participants were given a questionnaire, in which the grammaticality of each item had to be judged on a 7-point scale. In half of the questionnaires, “1” stood for “totally ungrammatical”, “7” for “totally grammatical”. In the other, these two poles were reversed, to counter-balance for possible left/right biases and possible preferences for higher numbers.

Instruction. Participants were instructed to judge the sentences spontaneously. They were also told that there were no right or wrong answers, and that it was their personal opinions about the sentences which were of interest. Instructions were given orally in English.

Results

Grammaticality Ratings. Mean grammaticality ratings by condition and group are shown in Figure 16, with exact values shown in Table 6.

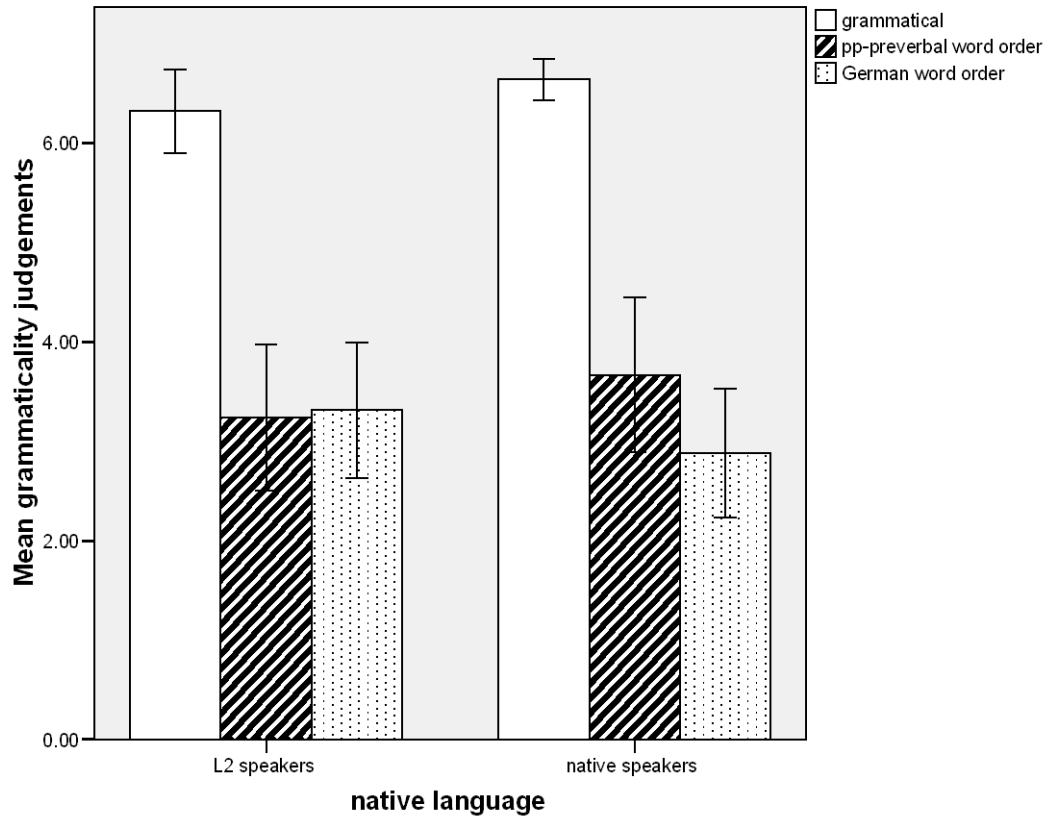


Figure 16. Mean grammaticality judgements by condition by native language in Experiment 6. Error bars represent 95% -confidence intervals.

Table 6
Experiment 6: Mean grammaticality judgements

	Condition		
	grammatical	pp-preverbal word order	German word order
whole sample	6.48	3.45	3.10
German group	6.32	3.23	3.31
Native group	6.64	3.67	2.88

We conducted a 3 (condition) x 2 (native language) x 2 (list) ANOVA. List was only included to account for possible error variance based on list, so effects involving the factor list are not reported.

Results showed a significant main effect of condition; $F_1(2, 60) = 184.72, p < .001$, $F_2(2, 54) = 610.37, p < .001$; with planned comparisons showing significantly lower grammaticality ratings for German word order than for grammatical word order; $F_1(1, 33) = 239.33, p < .001$; $F_2(1, 27) = 680.78, p < .001$; and significantly higher grammaticality ratings for pp-preverbal word order as opposed to German word order; $F_1(1, 33) = 7.27, p < .05$; $F_2(1, 27) = 24.35, p < .001$.

The main effect of native language was not significant; $F_1 < 1$; $F_2(1, 27) = 1.57, p > .1$.

The interaction between condition and native language was marginally significant by subjects and fully significant by items; $F_1(2, 60) = 2.95, p < .1$; $F_2(2, 54) = 20.36, p < .001$. To explore this interaction in greater detail, we conducted two separate 3 (condition) x 2 (list) ANOVAs, one for each of the two subject groups. For the German group, the ANOVA revealed a significant effect of condition; $F_1(2, 30) = 96.65, p < .001$; $F_2(2, 54) = 303.21, p < .001$, with planned comparisons showing significantly higher grammaticality judgements for the grammatically correct word order than for the German word order; $F_1(1, 15) = 109.33, p < .001$; $F_2(1, 27) = 301.77, p < .001$, but no difference between German and pp-preverbal word order (with both $F_1 < 1$ and $F_2 < 1$). Results for the native group also showed a significant effect of condition; $F_1(2, 30) = 91.73, p < .001$; $F_2(2, 54) = 592.43, p < .001$; with planned comparisons revealing significantly higher grammaticality ratings for the grammatically correct word order than for the German word order; $F_1(1, 15) = 144.35, p < .001$; $F_2(1, 27) = 730.54, p < .001$; and also significantly lower grammaticality ratings for German word

order as opposed to pp-preverbal word order; $F_1(1, 15) = 28.68, p < .001$; $F_2(1, 27) = 83.73, p < .001$. Thus, these planned comparisons suggest that the interaction between condition and native language is based on the fact that the native group shows a significant difference between the two ungrammatical conditions, with the German condition receiving lower grammaticality ratings than the pp-preverbal condition, while the German group does not show a difference between German and pp-preverbal word order.

Preliminary summary and discussion

Just as in Experiment 5, results show that L2 speakers are sensitive to word-order violations: L2 speakers, just as native speakers, showed significantly lower grammaticality rating for sentences with a German word order than for sentences with a grammatically correct word order

Unlike reading time measures from Experiment 5, however, grammaticality ratings for the L2 speakers showed no difference between the German and the pp-preverbal word order. In this respect, results showed an interaction between condition and native language, with native speakers showing a difference between the two ungrammatical conditions, while L2 speakers did not. In this respect, the pattern of results for the native group matches the reading-time pattern we found in Experiment 5, while this is not the case for the L2 group. A possible explanation for this is that grammaticality judgements of native speakers might be based on an impression that readers get while processing the sentence, while grammaticality judgments of L2 speakers might be based on explicit knowledge about L2 grammar. A participant who has been explicitly taught

that the pp-preverbal and the German word order are ungrammatical in English might judge both sentences as equally ungrammatical, despite the fact that he might still find one of the sentences easier to process than the other. In any case, results show that grammaticality judgements of L2 speakers and native speakers are, at least to some extent, not determined by the same factors.

With regard to the issue of shallow processing, the fact that L2 speakers show a significant effect of condition can be considered evidence against the Shallow-Structure Account, at least in its most extreme version: If L2 speakers had not computed any hierarchical structure, and had assigned thematic roles directly to the different constituents of the sentence without any prior syntactic analysis, the difference between the grammatical and German conditions should not have emerged for the L2 group.

With regard to L1 influence, while results show a significant interaction between condition and subject group, it is debatable whether this interaction can be interpreted as an effect of properties of the L1. If properties of the L1 had influenced the results, native speakers of German should have rated the German word order (which, while ungrammatical in English, is at least grammatical in their L1) as more grammatical than the PP-preverbal word order (which is ungrammatical in both the L1 and the L2). This, however, was not the case; instead, the interaction between condition and subject group was based on the fact that the German group did not show any difference between German and PP-preverbal word order, while the native group did show such a difference. In this respect, it is more likely that the interaction is a result of systematic differences in how native and non-native

speakers rate the grammaticality of a sentence, rather than the result of L1 influence.

As already mentioned, grammaticality judgments are an off-line measure referring to the ultimate outcome of processing. If L1 influence occurs during processing, but is relatively short-lived, an effect of L1 influence would not occur in grammaticality ratings, and would perhaps also not reach significance in reading time measures. The following experiment attempts to address this issue, by comparing eye-movement measures.

Experiment 7

While results of the previous experiments in this chapter show a clear picture with regard to shallow processing, the results are less clear with regard to the issue of a possible L1 influence. While the previous studies show no evidence of L1 influence, it is possible that such an effect is difficult to detect with relatively crude measures such as total-sentence reading times or grammaticality judgements. Furthermore, while dependent variables such as total-sentence reading times and grammaticality judgments can be used to investigate whether processing difficulty occurs for particular sentences, such variables do not tell us when exactly this processing difficulty occurs. The following experiment represents an attempt to address these issues.

Experiment 7 investigates how native and non-native speakers process syntactic violations such as the ones from Experiments 5 and 6 by measuring eye movements of native and non-native speakers while they read the respective sentences.

Additionally, a particular problem with the materials used in the previous studies deserves to be mentioned. Consider an example item such as (32a), (32b), and (32c) below (one of the items used in the previous experiments):

(32a) Peter painted the picture during the exhibition (...).

(32b) Peter during the exhibition painted the picture (...).

(32c) Peter painted during the exhibition the picture (...).

While both (32b) and (32c) are both ungrammatical, the two sentences become ungrammatical at different stages: In sentence (32b), the fact that the sentence is ungrammatical becomes clear relatively early, at *during the exhibition*. In sentence (32c), however, this is different: The verb *paint* could theoretically be intransitive; as a result, a sentence beginning such as *Peter painted during the exhibition...* is still grammatical. Thus, sentence (32c) only becomes ungrammatical when the parser gets to the direct object *the picture*. To some extent, comparing results for the constituent *during the exhibition* in sentence (32b) with results for the same constituent in sentence (32c) can be considered problematic, because in (32b) the sentence is already ungrammatical at *during the exhibition*, while in (32c), the sentence could potentially still be concluded in a grammatically correct way. It is possible that this difference (i.e. one sentence becoming ungrammatical at a different stage than the other) had an effect on reading times. To avoid this problem, some materials were changed so that all experimental items contain an

obligatorily transitive verb. Consider example sentences (33a), (33b), and (33c):

(33a) Peter sold the picture during the exhibition (...).

(33b) Peter during the exhibition sold the picture (...).

(33c) Peter sold during the exhibition the picture (...).

These sentences resemble sentences (32a) to (32c), with the exception that the potentially intransitive verb *paint* was substituted by the obligatorily transitive verb *sell*. As a result, when the parser reaches the prepositional phrase *during the exhibition*, it is already clear in both (33b) and (33c) that the sentence is ungrammatical. In this respect, the substitution of the verb avoids the problem of comparing a constituent in an ungrammatical sentence with the same constituent in a potentially still grammatical sentence.

Method

Participants. 18 native speakers of German (L2 group) and 18 native speakers of English (L1 group) with normal or corrected-to-normal vision participated in the experiment. All native speakers of German in the L2 group had learned English at school for 9 years, and had been living in an English-speaking environment for at least 3 months prior to testing. All of them considered themselves highly fluent in English, but not in any other foreign languages. All 18 participants in the L1 group were monolingual native speakers of English without advanced knowledge of any foreign language. None of them reported any knowledge of German.

Items. All experimental items were based on the materials used in Experiments 5-6. However, in order to account for the problem already mentioned above, some adjustments were made to avoid the problem of the conditions becoming ungrammatical at different stages.

All materials which already contained an obligatorily transitive verb were left unchanged. In all materials in which the above-mentioned problem occurred, the verb was substituted with an obligatorily transitive verb. On occasion, changing the verb also made it necessary to change other constituents in the sentence, such as the direct object. In total, however, changes were kept to a minimum. The adjusted materials are shown in Appendix C.

Design. The structure of the 3 lists was the same as in Experiments 5 and 6. Adjusted materials were added in the same positions as their original counterparts.

Procedure. Participants' eye movements were recorded at 1000 Hz using an SR Research Eyelink 1000 eye tracker with a spatial accuracy of approximately one letter space, monitoring the dominant eye of the respective participant. A chin rest was used to reduce head movements to a minimum. Participants were instructed to read the sentences silently for themselves, as naturally as possible, and at their normal reading speed. To ensure the accuracy of the measures, the tracker was calibrated every 15 sentences. After

the experiment, all participants completed the Oxford Placement Test as a measure of English proficiency.

Analyses. If a fixation was shorter than 80 ms and within one character space of either the previous or the next fixation, it was added to that fixation.

Results are reported for the following segments of the experimental items: prepositional phrase (e.g. *during the exhibition* in sentence (33a) above), verb (e.g. *sold*), direct object (e.g. *the picture*). The prepositional phrase can be considered the critical segment, in the sense that it is the point at which the sentence becomes ungrammatical in sentences such as (33b) and (33c).

We analysed the following eye-tracking measures. *First-pass reading time* is the sum of all fixation times (starting with the reader's first fixation inside the respective segment) until gaze leaves this segment, provided that the reader has not fixated any subsequent segments before. *Regression-path time* is the sum of all fixation times (again starting with the first fixation inside the segment) until gaze leaves this segment to the right. *Proportion of first-pass regressions* is the proportion of trials for which a regression from the given segment to any previous segment occurred. *Total time* is the sum of all fixations in the particular segment. If a reader entirely skipped a segment in one of these measures, showing a reading time of zero, the data for this segment was excluded from the analyses for that measure. Less than 1% of all data points were excluded on the basis of this criterion.

Measures are compared for the same constituents occurring in different positions.

Results

Proficiency. OPC scores for the German and the native English samples are shown in Figure 17, along with the scores of a norming sample of 32 native speakers of German living in Germany (the same norming sample as in Experiment 1). Proficiency of the German sample was significantly lower than proficiency of the native English sample; $t(34) = 3.38, p < .01$; but significantly higher than proficiency of the German norming sample; $t(48) = 8.89, p < .001$. In this respect, proficiency of the German sample in Experiment 7 can be assessed as very high, but not yet native-like.

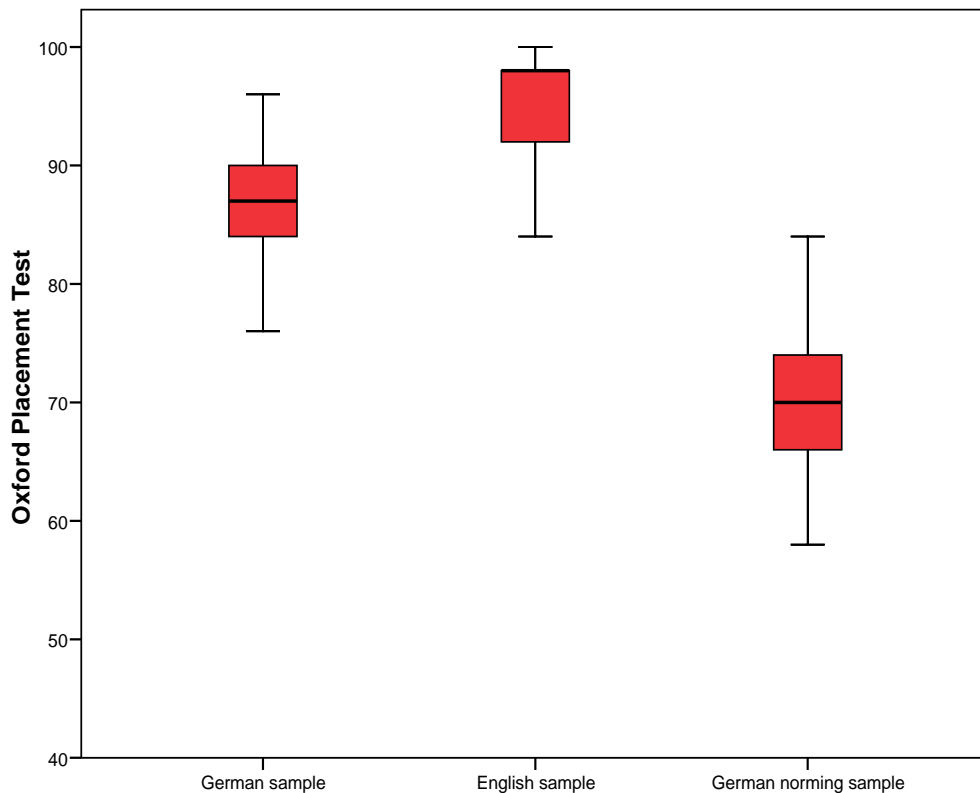


Figure 17: Oxford placement test scores for the German and native English samples in Experiment 7

Reading times. Table 7 shows mean reading times by condition, separately for each segment (verb, direct object, and prepositional phrase), each eye tracking measure (first-pass reading times, regression-path times, proportion of first-pass regressions, and total times) and subject group (L2 group, native group). For each eye-tracking measure and each segment, two 3 (condition) x 2 (subject group) x 3 (list) ANOVAs were conducted, one with subjects, one with items as the random factor. To account for error variance based on the fact that the experimental design consisted of 3 lists, participant/item list was added as a separate factor. As this was only done to account for possible error variance, effects involving the factor list are not reported.

If the ANOVAs showed a significant effect of condition for a particular segment and measure, planned-comparisons ANOVAs comparing (a) grammatically correct vs. German word-order and (b) German word-order vs. PP-preverbal word-order were conducted.⁸ Just as in the ANOVAs above, list was added as a between-subjects/between-items factor⁹. As this was only done to account for possible error variance based on list, interactions involving the factor list are not reported.

⁸ Note that for planned-comparisons tests, it is **problematic** to compare all three possible pairs of conditions. I decided to compare the German-word-order-condition with both control conditions.

⁹ Note that the inclusion of list is the reason for conducting ANOVAs, rather than t-tests, here.

Table 7
Experiment 7: Means

Condition		Segment		
		Verb	direct object	prep. phrase
First-pass reading times				
whole sample				
(1) grammatically correct (N-V-DO-PP)		325.99	356.53	522.93
(2) PP-preverbal (N-PP-V-DO)		297.68	335.55	589.15
(3) German word-order (N-V-PP-DO)		322.01	366.10	611.82
L2 group				
(1) grammatically correct (N-V-DO-PP)		295.58	369.68	533.31
(2) PP-preverbal (N-PP-V-DO)		296.35	351.89	601.38
(3) German word-order (N-V-PP-DO)		330.75	356.51	599.08
native group				
(1) grammatically correct (N-V-DO-PP)		329.56	329.20	499.92
(2) PP-preverbal (N-PP-V-DO)		289.02	303.91	564.66
(3) German word-order (N-V-PP-DO)		314.88	360.51	602.77
Regression-path times				
whole sample				
(1) grammatically correct (N-V-DO-PP)		376.75	432.71	626.25
(2) PP-preverbal (N-PP-V-DO)		342.96	416.48	753.08
(3) German word-order (N-V-PP-DO)		389.18	461.01	856.51
L2 group				
(1) grammatically correct (N-V-DO-PP)		341.94	450.11	612.91
(2) PP-preverbal (N-PP-V-DO)		335.55	409.18	732.61
(3) German word-order (N-V-PP-DO)		381.76	448.03	787.84
native group				
(1) grammatically correct (N-V-DO-PP)		382.86	389.72	625.28
(2) PP-preverbal (N-PP-V-DO)		342.93	385.47	753.25
(3) German word-order (N-V-PP-DO)		378.77	464.01	888.82
First-Pass Regressions				
whole sample				
(1) grammatically correct (N-V-DO-PP)		0.10	0.12	0.13
(2) PP-preverbal (N-PP-V-DO)		0.08	0.11	0.19
(3) German word-order (N-V-PP-DO)		0.11	0.12	0.28
L2 group				
(1) grammatically correct (N-V-DO-PP)		0.09	0.12	0.10
(2) PP-preverbal (N-PP-V-DO)		0.07	0.09	0.15
(3) German word-order (N-V-PP-DO)		0.10	0.13	0.21
native group				
(1) grammatically correct (N-V-DO-PP)		0.10	0.11	0.16
(2) PP-preverbal (N-PP-V-DO)		0.09	0.12	0.23
(3) German word-order (N-V-PP-DO)		0.11	0.11	0.34
Total times				
whole sample				
(1) grammatically correct (N-V-DO-PP)		470.57	516.68	740.29
(2) PP-preverbal (N-PP-V-DO)		414.74	457.96	893.95
(3) German word-order (N-V-PP-DO)		549.31	529.23	1022.09
L2 group				
(1) grammatically correct (N-V-DO-PP)		460.97	564.36	817.49
(2) PP-preverbal (N-PP-V-DO)		448.90	526.27	940.41
(3) German word-order (N-V-PP-DO)		562.32	568.41	1072.18
native group				
(1) grammatically correct (N-V-DO-PP)		453.93	453.78	661.36
(2) PP-preverbal (N-PP-V-DO)		372.36	372.90	836.57
(3) German word-order (N-V-PP-DO)		527.14	487.05	961.79

Prepositional Phrase. Results for the prepositional-phrase segment showed significant main effects of condition for first-pass reading times; $F(1, 60) = 10.27, p < .001$; $F(2, 54) = 12.02, p < .001$, regression path times; $F(1, 60) = 30.99, p < .001$; $F(2, 54) = 29.49, p < .001$, regressions; $F(1, 60) = 7.98, p < .001$; $F(2, 54) = 9.38, p < .001$, and total times; $F(1, 60) = 49.69, p < .001$; $F(2, 54) = 46.74, p < .001$.

For first pass-reading times, planned comparisons showed a significant difference between grammatically correct and German word-order ($F(1, 33) = 18.56, p < .001$; $F(1, 27) = 5.97, p < .05$), with slower first-pass reading times for German than for grammatically correct word-order, but no difference between PP-preverbal and German word-order ($F(1, 33) = 1.08, p > .1$; $F(1, 27) < 1$). For regression-path times, differences between grammatically correct and German word-order ($F(1, 33) = 69.13, p < .001$; $F(1, 27) = 16.77, p < .001$) and between PP-preverbal and German word-order ($F(1, 33) = 9.43, p < .01$; $F(1, 27) = 3.09, p < .1$) were significant. For first-pass regressions, planned comparisons showed a significant difference between grammatically correct and German word-order ($F(1, 33) = 19.62, p < .001$; $F(1, 27) = 5.80, p < .05$), while the difference between PP-preverbal and German word-order was only significant by-subjects, not by-items ($F(1, 33) = 4.23, p < .05$; $F(1, 27) = 2.14, p > .1$). Finally, for total times, planned comparisons showed significant differences between grammatically correct and German word-order ($F(1, 33) = 106.96, p < .001$; $F(1, 27) = 28.62, p < .001$) and between PP-preverbal and German word-order ($F(1, 33) = 14.73, p < .01$; $F(1, 27) = 10.38, p < .01$). For all four measures, the prepositional phrase was easiest to process if the sentence was grammatically

correct, slightly harder to process when the prepositional phrase occurred between the subject and the verb, and hardest to process when the prepositional phrase occurred between the verb and the direct object.

Regressions and total times also showed main effects of native language (First-pass regressions: $F(1, 30) = 4.39, p < .05$; $F(1, 27) = 22.04, p < .001$; total times: $F(1, 30) = 3.68, p < .1$; $F(1, 27) = 31.83, p < .001$), with L2 speakers showing longer reading times and fewer regressions than native speakers across all three conditions. For regression-path times and first-pass reading times, the main effects of native language were non-significant (with $p > .1$ in all cases).

Results for the prepositional-phrase segment also showed no interaction between condition and subject group for any of the four measures (first-pass reading times: $F(1, 26) < 1$; $F(2, 26) < 1$; regression-path times: $F(1, 26) < 1$; $F(2, 26) = 2.41, p > .1$; first-pass regressions: $F(1, 26) < 1$; $F(2, 26) = 1.22, p > .1$; total times: $F(1, 26) < 1$; $F(2, 26) < 1$)¹⁰.

Verb. For first-pass reading times and regression-path times, the main effect of condition was only significant by-items, but not by-subjects (First-pass reading times: $F(2, 60) = 2.13, p > .1$; $F(2, 54) = 3.44, p < .05$, Regression-path times: $F(2, 60) = 2.24, p > .1$; $F(2, 54) = 3.27, p < .05$). For first-pass regressions, the main effect of condition was non-significant; $F(2, 60) = 1.09, p > .1$; $F(2, 54) < 1$. For Total times, however, results showed a significant main effect of condition; $F(2, 60) = 15.76, p < .001$; $F(2, 54) = 16.97, p < .001$. Planned comparisons for total times showed that the verb was

¹⁰ As the possibility of an interaction between condition and subject group is important regarding possible effects of L1 influence, all interaction terms are reported in detail, even though they are non-significant.

more difficult to process for PP-preverbal than for German word-order; $F_1(1, 33) = 29.19, p < .001$; $F_2(1, 27) = 17.19, p < .001$. Planned comparisons also showed a significant difference between grammatically correct and German word-order; $F_1(1, 33) = 33.00, p < .01$; $F_2(1, 27) = 8.19, p < .01$; with the verb being more difficult to process for German than for grammatically correct word-order.

For first-pass-reading times, regression-path times, and regressions, all main effects of subject group were non-significant at the verb (with $p > .1$ for all analyses). For total times, the main effect of native language was non-significant by subjects (with Germans showing slower mean reading times than native speakers), but significant by items; $F_1(1, 30) = 1.48, p > .1$; $F_2(1, 27) = 6.73, p < .05$.

Again, interactions between condition and subject-group were non-significant in all four measures (first-pass reading times: $F_1 < 1$; $F_2(2, 26) = 3.12, p > .1$; regression-path times: $F_1 < 1$; $F_2(2, 26) = 1.23, p > .1$; first-pass regressions: $F_1 < 1$; $F_2 < 1$; total times: $F_1 < 1$; $F_2(2, 26) = 1.34, p > .1$).

Direct object. For first-pass reading times, the main effect of condition was only significant in the by-subjects analysis; $F_1(2, 60) = 7.37, p < .01$; $F_2(2, 54) = 1.95, p > .1$, while for regression-path times, it was only significant in the by items-analysis; $F_1(2, 60) = 1.85, p > .1$; $F_2(2, 54) = 3.78, p < .05$. For first-pass regressions, the main effect of condition was non-significant, $F_1 < 1$; $F_2 < 1$. For total times, however, results showed a significant main effect of condition; $F_1(2, 60) = 6.17, p < .01$, $F_2(2, 54) = 4.56, p < .05$. Planned comparisons for total times showed no significant difference between

grammatically correct and German word-order; $F_1 < 1$; $F_2 < 1$. The difference between PP-preverbal word-order and German word-order was only significant by subjects, but not by items; $F_1 (1, 33) = 8.78, p < .01$; $F_2 (1, 27) = 2.56, p > .1$.

For first-pass reading times, we found a main effect of subject group (with Germans showing slower mean reading times than native speakers), which was only significant by items; $F_1 (1, 30) = 2.73, p > .1$; $F_2 (1, 27) = 9.27, p < .01$. For regression-path times and regressions, no main effect of native language was observed (with $p > .1$ for all analyses), but total times showed a significant main effect of subject group, again with Germans showing slower mean reading times than native speakers; $F_1 (2, 60) = 6.17, p < .01$; $F_2 (2, 54) = 4.56, p < .05$.

Regression-path times, first-pass regressions, and total times showed no significant interactions between condition and subject group (regression-path times: $F_1 (2, 29) = 2.00, p > .05$; $F_2 (2, 26) = 1.75, p > .05$; first-pass regressions: $F_1 < 1$; $F_2 (2, 26) = 0.77, p > .05$; total times: $F_1 (2, 29) = 1.87, p > .05$; $F_2 (2, 26) = 1.54, P > .05$). For first-pass reading times, however, results showed an interaction, which was only marginally significant by items; $F_1 (2, 60) = 5.19, p < .01$; $F_2 (2, 54) = 2.92, p < .1$. To explore this interaction further, separate ANOVAs for each of the two subject groups were conducted. The ANOVA for the L2 group showed no main effect of condition; $F_1 < 1$; $F_2 < 1$. The ANOVA for the native group, however, showed a significant effect of condition; $F_1 (2, 30) = 12.05, p < .001$; $F_2 (2, 54) = 5.09, p < .01$. This suggests that the interaction between condition and subject group is based on the fact that the native group showed significant

differences between the conditions, while the L2 group did not. To confirm this, additional ANOVAs¹¹ were conducted for first-pass reading times from the native English group, one comparing grammatically correct and German word-order, the other comparing PP-preverbal and German word-order. Results from these planned comparisons showed a significant difference between PP-preverbal and German word-order, with German word-order being harder to process than PP-preverbal word-order ; $F_1(1, 15) = 33.60, p < .001$; $F_2(1, 27) = 11.44; p < .001$; and also a significant difference (only marginally significant by items) between grammatically correct and German word-order, with German word-order also being harder to process than grammatically correct word-order; $F_1(1, 15) = 4.59, p < .05$; $F_2(1, 27) = 2.97, p < .1$.

Preliminary summary and discussion

Results for the prepositional-phrase segment showed a number of significant effects of condition, but no significant interactions between condition and subject group.

Planned comparisons showed that for both groups, the German word-order, in which the prepositional phrase was incorrectly placed between verb and direct object, was more difficult to process than the grammatically correct condition. This suggests that the fact that the German word order was grammatically incorrect made the prepositional phrase more difficult to process than the grammatically correct word-order.

¹¹ Again, note that list was included as an additional factor in these analyses; this is why these tests are ANOVAs, rather than t-tests.

Interestingly, planned comparisons also showed significant differences between German word-order and PP-preverbal word-order, even though both conditions were grammatically incorrect. However, this difference can be explained by the particular processing difficulties caused by the incorrect position of the prepositional phrase: In the PP-preverbal condition, the prepositional phrase is incorrectly placed between the subject and the verb, presumably making it more difficult to assign the verb to the subject. While English does not allow a prepositional phrase to be placed in this position, English does allow other constituents to be placed between subject and verb, e.g. an apposition or a relative clause. Thus, the difficulty created by the fact that subject and verb are separated from each other might be relatively easy to solve for the parser, because the parser is familiar with other, grammatically correct, English sentences in which subject and verb are separated by an additional constituent. In the German word-order condition, the prepositional phrase is incorrectly placed between the monotransitive verb and the direct object, presumably making it more difficult to assign the direct object to the verb. In English, cases where a monotransitive verb and a direct object are separated by an additional constituent are relatively rare. As a result, assigning the direct object to the verb in the German word-order condition might be more difficult than assigning the verb to the subject in the PP-preverbal condition. In other words, while both PP-preverbal and German word-order are ungrammatical, it is possible that the particular problems caused by this are more severe in the German word-order condition than in the PP-preverbal condition.

In contradiction to the predictions of the Shallow-Structure Account, the significant effects of condition found for the prepositional-phrase segment suggest that L2 speakers are able to make use of word-order information in L2 sentences, and use this information in a similar way as native speakers. If L2 speakers had processed syntactic information (in this particular case, word order) more shallowly than L1 speakers, they should have been less affected by the different word orders in the three conditions. As a result, the L2 group should have differed from the native group in the sense that L2 speakers, unlike native speakers should not have shown an effect of condition. In this respect, results for the prepositional-phrase segment can be considered evidence against the Shallow-Structure Account.

With regard to the issue of L1 influence, the fact that the prepositional-phrase segment shows no signs of an interaction between condition and subject group in any of the four measures suggests that L2 speakers were not influenced by properties of their L1 while processing the prepositional phrase. L1 influence should have led to the German word-order being relatively easy to process for L2 speakers, because the word order in this condition is grammatical in L1 German. However, just as L1 speakers, L2 speakers found this condition more difficult to process than both grammatical and PP-preverbal word-order.

As far as the verb segment is concerned, results show a significant effect of condition for total times, with German word-order being harder to process than both PP-preverbal word-order and grammatically correct word-order. The difference between grammatical and German word-order suggests that participants were affected by whether the sentence was grammatically

correct or not. The difference between German word-order and PP-preverbal word-order can be attributed to the fact PP-preverbal word-order is already ungrammatical at the verb, while German word-order is still potentially grammatically correct at this constituent; this may have caused relatively superficial syntactic processing in the PP-preverbal condition, with participants relying less on syntactic information because it is already clear at this point that the sentence is ungrammatical, and that syntactic information is therefore not very reliable.

The fact that the main effect of condition reached significance for total times, but not always¹² in the earlier measures, can be explained by the fact that two of the grammatically correct and German conditions are still identical at the verb.

As far as the issue of L1 influence is concerned, the verb segment, just like the prepositional-phrase segment, shows no significant interactions between condition and subject group. Instead, results for the verb segment once again suggest that L2 speakers are sensitive to word-order violations, and deal with these violations in a similar way as native speakers.

Effects for the direct-object segment are similar to those for the verb segment: Again, we found a significant main effect of condition for total times, with the German condition being harder to process than both the grammatically correct and the PP-preverbal condition. These differences can be explained in a similar way as effects for the verb segment: Again, the German word-order shows longer total times than the grammatically correct word order because the German word-order is grammatically incorrect; the

¹² I.e. effects for first-pass reading times and regression-path times at the verb were only significant by-items, but not by-subjects.

German word order also shows longer total times than the PP-preverbal word-order, presumably because the PP-preverbal word-order becomes ungrammatical earlier, which may have caused superficial processing in the PP-preverbal condition. The German condition, in contrast, only becomes ungrammatical later, which may have resulted in longer total times.

With regard to the issue of L1 influence, regression-path times, first-pass regressions, and total times, show no signs of an interaction between condition and subject group for the direct-object segment. While we found such an interaction for first-pass reading times, it is highly debatable whether this interaction can be interpreted as a sign of L1 influence for a number of reasons: First, in the event of L1 influence, it would have been most likely to find such an interaction in the critical prepositional-phrase segment, rather than in the direct-object segment, because it is the position of the prepositional phrase which makes the sentence grammatical or ungrammatical. Second, the interaction, while significant by subjects, was only marginally significant by items. Third, the interaction occurred only in one segment, and even in this segment, only for one of the four measures. Fourth, post-hoc analyses showed that the interaction is based on the fact that the L2 group did not show any differences between the conditions at all, while the native group showed significant differences between the three conditions. Given this particular pattern, it is more likely that the interaction is caused by the fact that the native group already showed the effect in first-pass reading times, while for the L2 group, the same effect was slightly delayed, and thus only became significant in total times.

Chapter Summary

The previous chapter consists of a number of experiments investigating how L2 speakers and native speakers process sentences containing particular word-order violations. Results from reading times, grammaticality judgements, and eye movements all show differences between the grammatically correct versions of the sentences and their ungrammatical counterparts. This, combined with the fact that we found almost no interactions between condition and subject group¹³, suggests that L2 speakers are as sensitive to word-order violations as native speakers. Results also suggest that L2 speakers try to deal with these violations in a similar way as native speakers: Both for reading times and eye-movements, we found differences between the two ungrammatical conditions which can be explained by additional difficulty in attaching the direct object to the verb in sentences with German word order. In grammaticality ratings, however, this difference between the two ungrammatical conditions only emerged for native speakers, not for L2 speakers. This difference can be explained by assuming that grammaticality ratings of native speakers are based on the experience of processing the sentence, while L2 speakers might rate grammaticality on the basis of explicit knowledge of L2 grammar.

Unlike Experiments 1-4, this set of experiments showed hardly any signs of L1 influence: We found no interaction between condition and subject group in

¹³ With the exception of an interaction for first-pass reading times in the direct-object-section in Experiment 7; see the discussion section for Experiment 7.

the reading-time experiment, and (with the exception of a single interaction in first-pass reading times at the direct-object-segment, for which it is highly doubtful whether it represents an effect of L1 influence, see above) also no such interactions in the eye-movement study. Also, the fact that the word order in a grammatically incorrect English sentence is grammatically correct in L1 German did not make processing of these sentences easier for native speakers of German. Instead, in the reading-time study, sentences which were ungrammatical in English, but grammatical in German, actually took longer to process than sentences such as (4c), which are ungrammatical in both the L1 and the L2. The same difference also occurred for a number of segments and measures in the eye-tracking study. Thus, it has to be concluded that, at least as far as on-line processing of these particular sentences is concerned, properties of the L1 did not influence processing.

As already briefly pointed out in the preliminary conclusions, this pattern of effects is difficult to account for by the Shallow-Structure Account, for two reasons: First, the account assumes qualitative differences between L1 and L2 processing. These qualitative differences resulted in significant interactions between condition and subject group, but such interactions did not emerge. Second, the account assumes that L2 speakers process syntactic information shallowly, and, at least in its most extreme version (Clahsen & Felser, 2006), claims that L2 speakers assign thematic roles directly to the various constituents, without performing a syntactic analysis. Results from all experiments in this chapter, however, show that L2 speakers are as sensitive

to syntactic information (in this particular case, word order) as native speakers.

CHAPTER 8

General Discussion

In Chapters 6 and 7, I presented two sets of experiments investigating the influence of the L1 on L2 syntactic processing. Experiments 1-4 presented L2 speakers with L2 sentences consisting of a word-order which also exists in their L1, but represents different syntactic structures in both languages. The observed data pattern suggests that L2 speakers temporarily activated the German syntactic structure while processing these English sentences. Experiments 5-7 investigated how L2 speakers process L2 sentences with a word order which is ungrammatical in the L2, but which would be grammatical in the L1. The data pattern from this second data set suggests that L2 speakers were not affected by properties of their L1, but instead processed the syntactic structures of these sentences in a similar way as native speakers.

Thus, the first set of experiments suggests that syntactic properties of the L1 affect L2 syntactic processing, while the second set of experiments suggests that the L2 syntactic processing is unaffected by properties of the L1. It appears as if L2 processing is sometimes, but not always, influenced by the native language. In this respect, no current account of L2 syntactic processing can fully account for the findings presented above: Clahsen & Felser's (2006) shallow-structure account assumes that L2 speakers can only compute a very shallow representation of the syntactic structure of an L2 sentence, which is considered too rudimentary for properties of the L1 to have an effect. This account fails to predict the effect of L1 influence observed in the first set of experiments. MacWhinney's (1997) Competition Model assumes that L2 speakers should experience effects of L1 influence on all levels of language processing, including syntactic parsing. This account

cannot explain the absence of an effect of L1 influence in the second set of experiments.

In order to be able to explain the results from both sets of experiments, it is necessary to assume an account which allows for effects of the L1 to occur, but only under specific circumstances. In the following, I propose a constraint-based account of L2 syntactic processing which is based on this assumption. Note, however, that Experiments 1-4 differ from Experiments 5-7 in a number of ways; they are not two conditions within a single experiment, but actually two entirely separate sets of studies. In this respect, any account which attempts to explain why the first set of experiments shows an effect of L1 influence, while the second set of experiments does not, involves a degree of speculation.

Syntactic processing involves the activation of a memory representation of an appropriate syntactic structure. In this process, I assume that while a parser processes a sentence, different syntactic structures compete for activation: For each property of a syntactic structure which fits in with a property of the sentence, the particular syntactic structure receives a certain amount of activation. The syntactic structure which receives the highest amount of activation wins, and is ultimately selected by the parser. The amount of activation each syntactic structure receives is determined by a number of constraints. Such constraints may include the language of the sentence (i.e. whether the sentence is an L1 or an L2 sentence), language context (such as being in a code-switching vs. a non-code-switching

situation¹⁴), the frequency with which a structure has been encountered before, and the complexity of the structure.

The account assumes that in principle, all syntactic structures which an L2 speaker knows, no matter from which language, compete for activation. This includes syntactic structures which are shared between languages, structures which are only possible in the L1, and structures which are only possible in the L2. Thus, it is theoretically possible that a syntactic structure from the L1 is activated during processing of an L2 sentence. However, the language of the sentence serves as one of several constraints determining the amount of activation each structure receives. As a result, if an L2 speaker reads an L2 sentence, all L2 syntactic structures receive a certain amount of activation because the sentence is in the L2. In metaphorical terms, both L1 and L2 structures compete for activation, but L2 structures are given a head-start thanks to the fact that the sentence is an L2 sentence. If, however, a sufficient number other constraints match properties of an L1 structure, it is that an L1 structure might still win the race.

How would such an account explain the presence of an effect of L1 influence found in the first set of experiments? In order to answer this question, it is useful to predict the distribution of activation during the initial segments of the experimental sentences used in Experiments 1-4, while a native speaker of German processes the sentence from left to right:

¹⁴ I add contextual information as an additional constraint here, based on the fact that Experiment 1 showed an effect of L1 influence, while Experiment 4 did not. Note, however, that in the combined analysis of the two experiments, the 3-way-interaction code-switching x type of relative clause x type of sentence beginning was only marginally significant. However, the combined analysis showed a main effect of code-switching; in other words, while it is not totally clear whether code-switching affects L1 influence, results suggest that the presence or absence of a code-switching situation at least has an effect on L2 processing in general.

(34) When the barmaid/ Damian/ deceived and/ betrayed/... .

How might the relative levels of activation be distributed across the possible syntactic structures before the parser reaches *betrayed*? The language of the sentence is English; thus, one of the constraints mentioned above favours the English reduced-relative structure. For the other constraints, however, this is different: Because Experiment 1 puts participants in a code-switching situation, the contextual constraint favours L1 structures over L2 structures. The correct English syntactic structure (a reduced relative clause embedded in a subordinate clause) is relatively rare in English, while the structure of the German word-by-word translation) is relatively frequent in German, so the Frequency constraint can also be considered to favour the L1 structure. Finally, the correct English syntactic structure is relatively complex (e.g., it involves three levels of embedding), while the competing German syntactic structure is considerably less complex (a relatively simpler verb-final subordinate-SOV structure).

As a result, one of the constraints mentioned above favours the English syntactic structure, while several other constraints favour the German structure. Thus, the total amount of activation of the German subordinate-SOV structure might initially exceed the amount of activation of the English reduced-relative-structure. The processing of a cross-linguistic garden-path sentence is illustrated in Figure 18 below.

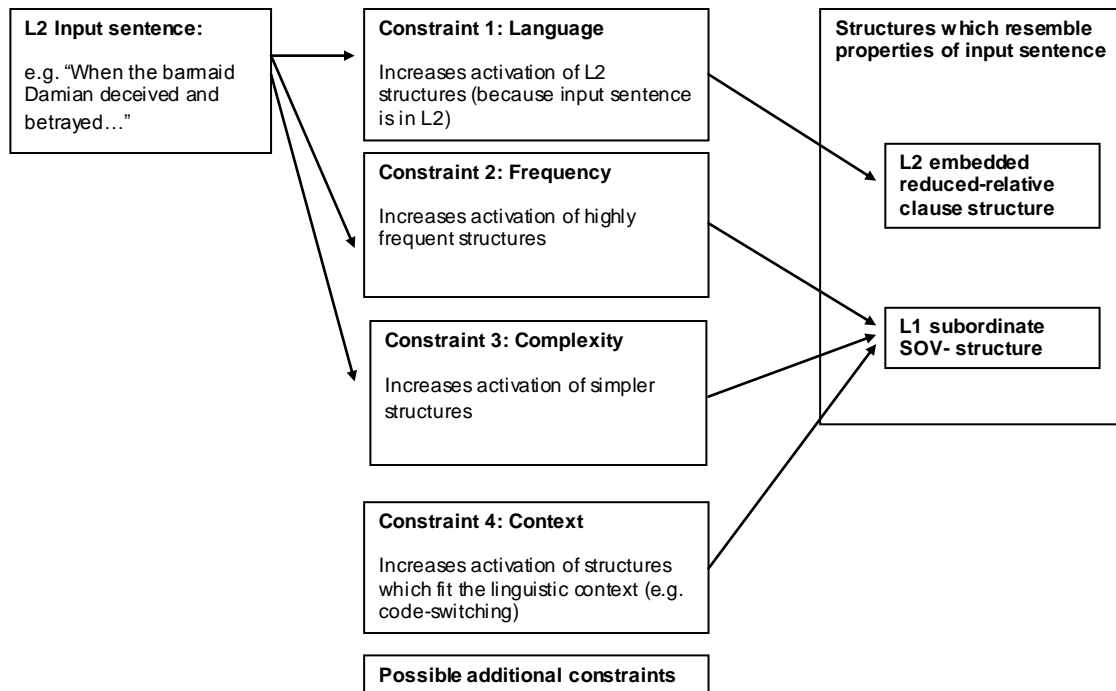


Figure 18: Processing of a cross-linguistic garden-path sentence on the basis of a constraint-based account of L2 syntactic processing

In how far can the account explain why the effect of L1 influence occurs at *betrayed*, rather than at another segment of the sentence? The fact that we found an effect of L1 influence at *betrayed* suggests a change in the relative levels of activation each syntactic structure receives, at this segment. As already mentioned in the preliminary discussion above, this change might occur as a result of the fact that coordinated verbs are rare in German subordinate clauses. The introduction of the coordinated verb also makes the German structure considerably more complex. While before *betrayed* the frequency and complexity constraints clearly favoured the German structure over the English structure, this might change with the introduction of a coordinated verb. This could explain why the effect occurs in this segment. Alternatively, it is also possible that the effect is the result of a clause-wrap-up process, during which the processor double-checks whether the

coordinated verb is attached to the appropriate subject in the correct way. During such a clause-wrap-up process, the fact that the language of the sentence is English might receive a higher priority, which might allow the parser to realize that the German structure is inappropriate.

A constraint-based account such as the one described above can also account for the absence of an effect of L1 influence in Experiments 5-7. I already mentioned that the experimental sentences used in Experiments 1-4 consisted of a word order that could be considered temporarily ambiguous for an L2 speaker, in the sense that the word order of these sentences resembles a competing syntactic structure from the L1. In the context of the above constraint-based model, two possible structures (one from the L1, the other from the L2) compete for activation. For the materials in Experiments 5-7, this is different. Let us take another look at example sentence (35):

(35) *David baked during the break the rolls.

The sentence is ungrammatical in English. However, if a parser still attempts to process the sentence, the only way to do so is to interpret the constituent *during the break* as a temporal phrase, and the constituent *the rolls* as a direct object of the verb *baked*. In this respect, unlike in the cross-linguistic garden-path sentences used in Experiments 1-4, there is no ambiguity regarding the assignment of syntactic functions in sentence (35). In other words, readers do not adopt an incorrect analysis here, so there cannot be a disruption because readers discover that their initial analysis is incorrect. In sum, I suggest that an effect of L1 influence may occur when the L1 and L2 favour different

syntactic role assignments, but not when the assignment of syntactic roles is unambiguous anyway.

In how far is the account able to explain the different results obtained from other studies investigating syntactic L1 influence? To discuss this, it is useful to have another look at the properties of a relative-clause-attachment ambiguity such as (36) (from Dussias, 2003):

- (36) Peter fell in love with the daughter of the psychologist who studied in California.

Just as in the case of a cross-linguistic garden-path sentence, the parser has to decide between two possible syntactic structures in sentence (36), because the relative clause *who studied in California* can either be attached high (to *the daughter*) or low (to *the psychologist*). While both of these structures exist in both the L1 and the L2, a number of languages favour high attachment, while other languages favour low attachment. In the case of Dussias (2003), one of the two structures was favoured by the L1, while the other was favoured by the L2. In a questionnaire study, Dussias (2003) found an effect of L1 influence for native speakers of English reading L2 Spanish sentences (in the sense that the English preference for low attachment was transferred to L2 reading), but not for native speakers of Spanish reading English sentences. In the case of native speakers of English reading L2 Spanish sentences, the Language constraint favoured high attachment, because Spanish possesses a preference for high attachment. The Frequency constraint presumably favoured neither high nor low attachment, as one structure is more frequent in

the L1, while the other is more frequent in the L2. The Complexity and Context constraints, however, favoured low attachment: Low attachment can be considered syntactically less complex than high attachment, because the noun to which the relative clause is attached is right next to the relative clause. In the case of high attachment, the distance between the relative clause and its referent is larger, resulting in a higher degree of complexity. In fact, in research on ambiguity resolution in L1, it has been proposed that low attachment might be less costly in terms of processing resources (e.g. Frazier, 1978; Frazier & Clifton, 1996). Finally, with regard to the Context constraint, the participants in Dussias' (2003) study were native speakers of English who were tested while living in an English-speaking environment, were instructed in English, and actually also had to complete an English questionnaire in the context of the same study. In other words, the L1 was highly activated in the given context. In sum, it is possible that the activation from the Complexity and Context constraints (which favoured low attachment) was stronger than the activation from the Language constraint (which favoured high attachment). This might have resulted in the effect of L1 influence found in the study.

Dussias (2003) also tested native speakers of Spanish reading English versions of the same relative-clause-attachment ambiguities. In this case, the Language and Frequency constraints favoured low attachment (in both cases because English is a language favouring low attachment). The Complexity constraint also favoured low attachment, again because in the case of low attachment, the relative clause is closer to the noun to which it is attached. Finally, the Context constraint also favoured low attachment, because

participants were tested in an English-dominant environment. In sum, it is possible that an effect of L1 influence (in the sense that readers would show a preference for high attachment, because their L1 Spanish is a language favouring high attachment) did not occur for the native Spanish group, because unlike for the native English group, all four constraints favoured low attachment.

In a similar way, the account could also explain the findings from Papadopoulou & Clahsen (2003) described in Chapter 4. In this study, the authors investigated processing of relative-clause attachments in L2 Greek, a language favouring high attachment, by native speakers of various L1 backgrounds which also favoured high attachment. They found that even though both the L1 and the L2 favoured high attachment, the L2 speakers showed no preference for either high or low attachment. While the Language constraint favoured high attachment, the Complexity constraint favoured low attachment, again because low attachment can be considered less complex than high attachment. The Frequency and Context constraints can be assumed to favour neither high nor low attachment in this case. As a result, both high and low attachment received a certain degree of activation, which could explain why the L2 speakers in this study showed no clear preference for either high or low attachment.

In how far can the account also explain results from studies using the sentence-interpretation paradigm, such as the study by I-Ru Su (2001) described in Chapter 5? In this study, native speakers of English read L2 Chinese versions of word strings such as (37):

(37) The stone hits the girl.

I-Ru-Su (2001) showed that native speakers of English transferred strategies for syntactic-role assignment from their L1 to L2 Chinese, in the sense that they relied mainly on word order (a strong cue in their L1) to assign syntactic roles to the constituents, while native speakers of Chinese reading in their native language mainly relied on animacy. In terms of the constraint-based account described above, the parser has to decide between two syntactic structures in this case: an S-V-O structure (favoured in English, because it is the dominant word order in English) and an O-V-S structure (favoured in Chinese, because *the girl* is animate, while *the stone* is inanimate). The Language constraint favours the O-V-S structure in this case, because the word string is in L2 Chinese, a language in which animacy can be considered a more reliable cue for syntactic-role assignment than word order. The Complexity constraint favours neither the S-V-O structure nor the O-V-S structure. The Frequency constraint, however, can be considered to favour the S-V-O structure: In English, the O-V-S structure is ungrammatical English, so in their L1, native speakers of English have encountered the S-V-O structure far more often than the O-V-S structure. Because Chinese is free with regard to word order, both the S-V-O structure and the O-V-S structure are reasonably frequent. Thus, the overall frequency across languages favours the S-V-O structure. Finally, the Context constraint also favours the S-V-O structure: as all native speakers of English were tested in an English-speaking country and instructions were also given in English. In sum, only the Language constraint favours the O-V-S structure, while both the Frequency

and Context constraints favour the S-V-O structure. This explains why the native English sample in I-Ru-Su's (2001) study relied primarily on word order while processing the Chinese word strings.

In sum, the constraint-based account described above can be considered a first step towards explaining why previous studies on L1 influence have come to different conclusions. The constraint-based account is able to explain why an effect of L1 influence emerged in Experiments 1-4, but not in Experiments 5-7. The account can also account for results from studies on relative-clause attachment ambiguities, and offers a possible explanation for why studies such as Dussias (2003) and Papadopoulou & Clahsen (2003) have come to different conclusions regarding L1 influence. Finally, the account also offers an explanation for the effects of L1 influence which emerged in studies using sentence interpretation, such as I-Ru-Su (2001).

Aside from the issue of possible effects of L1 influence, the effects observed for L1 and L2 speakers in the two sets of experiments share a large amount of similarity: In Experiments 1-4, all L1 and L2 samples, irrespective of native-language background, show effects of the presence or absence of a *who* introducing the relative clause. For all samples, these effects also occur in approximately the same areas of the sentence. This suggests that L1 and L2 speakers use the lexico-syntactic information conveyed by the *who* in a very similar way. The fact that for all samples, the effect of the inclusion of a *who* occurred relatively late in the sentence suggests that both L1 and L2 speakers are equally successful in using this type of lexico-syntactic information to get a clearer picture of the levels of embedding that the sentence contains.

In Experiment 5, reading times of L1 and L2 speakers were affected by word-order violations in very similar ways: Both L1 and L2 speakers processed the grammatical versions of the sentences faster than the ungrammatical ones, and both L1 and L2 speakers experienced more difficulty in ungrammatical sentences in which verb and direct object were separated from each other, as compared with ungrammatical sentences in which this was not the case. This suggests that L1 and L2 speakers solve basic tasks involved in syntactic processing, such as attaching a direct object to its verb, in a similar way.

All this suggests that L1 and L2 processing have a lot in common. In this respect, results fit in with the basic predictions of the Competition Model. The Competition Model assumes that both L1 and L2 processing are in principle based on the same mechanisms, in the sense that both involve the task of mapping linguistic forms onto functions. In the case of syntactic processing, this involves using surface information (e.g. word order, lexico-syntactic information, animacy, etc.) to construct a representation of the syntactic structure of a sentence. In this respect, the Competition Model assumes that both L1 and L2 speakers can in principle make use of all types of surface information; L1 and L2 processing is assumed to differ only in terms of the *weight* that L1 and L2 speakers assign to certain bits of surface information, such as word order. Thus, as the model assumes that L2 speakers, just as L1 speakers can in principle process all types of surface information contained in the sentence, the model can explain why we found similar effects of the inclusion of *who* in Experiments 1-4, and similar effects of word-order violations in Experiments 5 and 6. In sum, while the

Competition Model cannot account for the lack of effects of L1 influence in Experiments 5-7, it can account for the fact that full relative clauses were easier to process than reduced relative clauses in Experiments 1-4, and can also explain the effects of word-order violations in Experiments 5 and 6. The Shallow-Structure Account, in contrast, finds it considerably more difficult to explain the similarity between the data patterns for L1 and L2 speakers: Unlike the Competition Model, the Shallow-Structure Account assumes qualitative differences between L1 and L2 processing. Such qualitative differences should result in different data patterns for L1 and L2 groups; Experiments 5-7, however, showed relatively similar basic patterns of effects for L1 and L2 speakers.

Overall Summary and Closing Remarks

While both the Shallow-Structure Account and the Competition Model can be considered categorical in the sense that an effect of L1 influence either always or never occurs, the results from the two sets of Experiments described above present a more diverse picture, in which L1 influence can theoretically occur, but only if specific circumstances are present. I propose the above constraint-based account as a first step towards an integrated model of L2 processing, which should specify under which circumstances L2 speakers are affected by syntactic properties of their L1.

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Appendix A: Materials used in Experiments 1-4

The list contains all experimental items used in Experiments 1-4. For each item, all 4 conditions are shown. The order of the four conditions indicates which list each version of the respective item belongs to: The first version of each item belongs to list 1, the second to list 2, and so on. Dashes between words mark the segment boundaries in the self-paced reading task.

When the classmate/ Richard/ noticed and/ greeted/ tried/ to leave/ the station/
the train/ arrived.

The classmate/ Richard/ noticed and/ greeted/ tried/ to leave/ the station/
when the train/ arrived.

When the classmate/ who Richard/ noticed and/ greeted/ tried/ to leave/ the
station/ the train/ arrived.

The classmate/ who Richard/ noticed and/ greeted/ tried/ to leave/ the station/
when the train/ arrived.

The lady/ Lindsay/ visited and/ helped/ began/ to tell/ stories/ while the whole
family/ listened.

When the lady/ who Lindsay/ visited and/ helped/ began/ to tell/ stories/ the
whole family/ listened.

The lady/ who Lindsay/ visited and/ helped/ began/ to tell/ stories/ while the
whole family/ listened.

When the lady/ Lindsay/ visited and/ helped/ began/ to tell/ stories/ the whole family/ listened.

When the sportsman/ who Stephen/ trained and/ coached/ decided/ to leave/ the room/ the team captain/ looked/ very angry.

The sportsman/ who Stephen/ trained and/ coached/ decided/ to leave/ the room/ when the team captain/ looked/ very angry.

When the sportsman/ Stephen/ trained and/ coached/ decided/ to leave/ the room/ the team captain/ looked/ very angry.

The sportsman/ Stephen/ trained and/ coached/ decided/ to leave/ the room/ when the team captain/ looked/ very angry.

The girl/ who Thomas/ amused and/ entertained/ started/ to sing/ the song/ when the music/ started/ playing.

When the girl/ Thomas/ amused and/ entertained/ started/ to sing/ the song/ the music/ started/ playing.

The girl/ Thomas/ amused and/ entertained/ started/ to sing/ the song/ when the music/ started/ playing.

When the girl/ who Thomas/ amused and/ entertained/ started/ to sing/ the song/ the music/ started/ playing.

When the outlaw/ who Gabriel/ chased and/ scared/ wanted/ to draw/ the sword/ the noble knight/ suddenly arrived.

The outlaw/ who Gabriel/ chased and/ scared/ wanted/ to draw/ the sword/ when the noble knight/ suddenly arrived.

When the outlaw/ Gabriel/ chased and/ scared/ wanted/ to draw/ the sword/
the noble knight/ suddenly arrived.

The outlaw/ Gabriel/ chased and/ scared/ wanted/ to draw/ the sword/ when
the noble knight/ suddenly arrived.

After the manager/ Douglas/ supported and/ assisted/ agreed/ to raise/ the
salaries/ the office workers/ started/ working harder.

The manager/ Douglas/ supported and/ assisted/ agreed/ to raise/ the salaries/
after the office workers/ started/ working harder.

After the manager/ who Douglas/ supported and/ assisted/ agreed/ to raise/ the
salaries/ the office workers/ started/ working harder.

The manager/ who Douglas/ supported and/ assisted/ agreed/ to raise/ the
salaries/ after the office workers/ started/ working harder.

The youth/ who Christopher/ attacked and/ wounded/ prepared/ to block/ the
next punch/ when the crowd/ started/ shouting.

When the youth/ Christopher/ attacked and/ wounded/ prepared/ to block/ the
next punch/ the crowd/ started/ shouting.

The youth/ Christopher/ attacked and/ wounded/ prepared/ to block/ the next
punch/ when the crowd/ started/ shouting.

When the youth/ who Christopher/ attacked and/ wounded/ prepared/ to
block/ the next punch/ the crowd/ started/ shouting.

The barmaid/ Damian/ deceived and/ betrayed/ attempted/ to steal/ the
spoons/ when nobody/ paid attention.

When the barmaid/ who Damian/ deceived and/ betrayed/ attempted/ to steal/
the spoons/ nobody/ paid attention.

The barmaid/ who Damian/ deceived and/ betrayed/ attempted/ to steal/ the
spoons/ when nobody/ paid attention.

When the barmaid/ Damian/ deceived and/ betrayed/ attempted/ to steal/ the
spoons/ nobody/ paid attention.

When the smuggler/ Andrew/ observed and/ followed/ hurried/ to conceal/ the
drugs/ a police officer/ appeared.

The smuggler/ Andrew/ observed and/ followed/ hurried/ to conceal/ the
drugs/ when a police officer/ appeared.

When the smuggler/ who Andrew/ observed and/ followed/ hurried/ to
conceal/ the drugs/ a police officer/ appeared.

The smuggler/ who Andrew/ observed and/ followed/ hurried/ to conceal/ the
drugs/ when a police officer/ appeared.

While the teenager/ who Philip/ bullied and/ offended/ decided/ to tell/ a
teacher/ the other students/ ignored/ what was happening.

The teenager/ who Philip/ bullied and/ offended/ decided/ to tell/ a teacher/
while the other students/ ignored/ what was happening.

While the teenager/ Philip/ bullied and/ offended/ decided/ to tell/ a teacher/
the other students/ ignored/ what was happening.

The teenager/ Philip/ bullied and/ offended/ decided/ to tell/ a teacher/ while
the other students/ ignored/ what was happening.

The Englishman/ Jonathan/ criticised and/ ridiculed/ continued/ to push/ the employees/ when the colleagues/ started to complain/ about the work.

When the Englishman/ who Jonathan/ criticised and/ ridiculed/ continued/ to push/ the employees/ the colleagues/ started to complain/ about the work.

The Englishman/ who Jonathan/ criticised and/ ridiculed/ continued/ to push/ the employees/ when the colleagues/ started to complain/ about the work.

When the Englishman/ Jonathan/ criticised and/ ridiculed/ continued/ to push/ the employees/ the colleagues/ started to complain/ about the work.

The employee/ who Martha/ educated and/ instructed/ failed/ to complete/ the work/ when the company was/ in serious trouble.

When the employee/ Martha/ educated and/ instructed/ failed/ to complete/ the work/ the company was/ in serious trouble.

The employee/ Martha/ educated and/ instructed/ failed/ to complete/ the work/ when the company was/ in serious trouble.

When the employee/ who Martha/ educated and/ instructed/ failed/ to complete/ the work/ the company was/ in serious trouble.

While the beggar/ who Robert/ injured and/ humiliated/ tried/ to leave/ the mall/ lots of people/ were passing by.

The beggar/ who Robert/ injured and/ humiliated/ tried/ to leave/ the mall/ while lots of people/ were passing by.

While the beggar/ Robert/ injured and/ humiliated/ tried/ to leave/ the mall/ lots of people/ were passing by.

The beggar/ Robert/ injured and/ humiliated/ tried/ to leave/ the mall/ while
lots of people/ were passing by.

The woman/ who Sandra/ sketched and/ painted/ decided/ to have/ a coffee/
when it was/ already late/ in the evening.

When the woman/ Sandra/ sketched and/ painted/ decided/ to have/ a coffee/
it was/ already late/ in the evening.

The woman/ Sandra/ sketched and/ painted/ decided/ to have/ a coffee/ when
it was/ already late/ in the evening.

When the woman/ who Sandra/ sketched and/ painted/ decided/ to have/ a
coffee/ it was/ already late/ in the evening.

The celebrity/ Carolyn/ recognised and/ befriended/ preferred/ to date/ another
woman/ while the whole city/ was talking/ about the relationship.

While the celebrity/ who Carolyn/ recognised and/ befriended/ preferred/ to
date/ another woman/ the whole city/ was talking/ about the relationship.

The celebrity/ who Carolyn/ recognised and/ befriended/ preferred/ to date/
another woman/ while the whole city/ was talking/ about the relationship.

While the celebrity/ Carolyn/ recognised and/ befriended/ preferred/ to date/
another woman/ the whole city/ was talking/ about the relationship.

When the stranger/ Martin/ followed and/ attacked/ managed/ to reach/ the
car/ the police/ suddenly/ arrived.

The stranger/ Martin/ followed and/ attacked/ managed/ to reach/ the car/
when the police/ suddenly/ arrived.

When the stranger/ who Martin/ followed and/ attacked/ managed/ to reach/
the car/ the police/ suddenly/ arrived.

The stranger/ who Martin/ followed and/ attacked/ managed/ to reach/ the car/
when the police/ suddenly/ arrived.

The secretary/ who Jennifer/ punished and/ insulted/ continued/ to offend/
everyone/ while the manager/ did not pay/ any attention/ at all.

While the secretary/ Jennifer/ punished and/ insulted/ continued/ to offend/
everyone/ the manager/ did not pay/ any attention/ at all.

The secretary/ Jennifer/ punished and/ insulted/ continued/ to offend/
everyone/ while the manager/ did not pay/ any attention/ at all.

While the secretary/ who Jennifer/ punished and/ insulted/ continued/ to
offend/ everyone/ the manager/ did not pay/ any attention/ at all.

When the man/ Shirley/ left and/ rejected/ wanted/ to renew/ the relationship/
things/ seemed to be/ improving.

The man/ Shirley/ left and/ rejected/ wanted/ to renew/ the relationship/ when
things/ seemed to be/ improving.

When the man/ who Shirley/ left and/ rejected/ wanted/ to renew/ the
relationship/ things/ seemed to be/ improving.

The man/ who Shirley/ left and/ rejected/ wanted/ to renew/ the relationship/
when things/ seemed to be/ improving.

The prince/ Lancelot/ captured and/ imprisoned/ prepared/ to escape/ the
prison/ when the knights/ got back/ to the castle.

When the prince/ who Lancelot/ captured and/ imprisoned/ prepared/ to escape/ the prison/ the knights/ got back/ to the castle.

The prince/ who Lancelot/ captured and/ imprisoned/ prepared/ to escape/ the prison/ when the knights/ got back/ to the castle.

When the prince/ Lancelot/ captured and/ imprisoned/ prepared/ to escape/ the prison/ the knights/ got back/ to the castle.

When the politician/ who Victoria/ financed and/ managed/ requested/ to read/ the report/ the chief of staff/ quit.

The politician/ who Victoria/ financed and/ managed/ requested/ to read/ the report/ when the chief of staff/ quit.

When the politician/ Victoria/ financed and/ managed/ requested/ to read/ the report/ the chief of staff/ quit.

The politician/ Victoria/ financed and/ managed/ requested/ to read/ the report/ when the chief of staff/ quit.

After the manager/ Benjamin/ employed and/ promoted/ decided/ to quit/ the job/ the company/ got in/ real trouble.

The manager/ Benjamin/ employed and/ promoted/ decided/ to quit/ the job/ after the company/ got in/ real trouble.

After the manager/ who Benjamin/ employed and/ promoted/ decided/ to quit/ the job/ the company/ got in/ real trouble.

The manager/ who Benjamin/ employed and/ promoted/ decided/ to quit/ the job/ after the company/ got in/ real trouble.

The man/ William/ questioned and/ provoked/ refused/ to tell/ the truth/ while the family/ of the victim/ was watching/ the interrogation.

While the man/ who William/ questioned and/ provoked/ refused/ to tell/ the truth/ the family/ of the victim/ was watching/ the interrogation.

The man/ who William/ questioned and/ provoked/ refused/ to tell/ the truth/ while the family/ of the victim/ was watching/ the interrogation.

While the man/ William/ questioned and/ provoked/ refused/ to tell/ the truth/ the family/ of the victim/ was watching/ the interrogation.

The toddler/ who Rebecca/ kicked and/ scratched/ attempted/ to leave/ the room/ when an adult/ came in.

When the toddler/ Rebecca/ kicked and/ scratched/ attempted/ to leave/ the room/ an adult/ came in.

The toddler/ Rebecca/ kicked and/ scratched/ attempted/ to leave/ the room/ when an adult/ came in.

When the toddler/ who Rebecca/ kicked and/ scratched/ attempted/ to leave/ the room/ an adult/ came in.

While the villain/ who Macbeth/ defeated and/ killed/ failed/ to conquer/ the country/ other enemies/ were gathering/ armies.

The villain/ who Macbeth/ defeated and/ killed/ failed/ to conquer/ the country/ while other enemies/ were gathering/ armies.

While the villain/ Macbeth/ defeated and/ killed/ failed/ to conquer/ the country/ other enemies/ were gathering/ armies.

The villain/ Macbeth/ defeated and/ killed/ failed/ to conquer/ the country/
while other enemies/ were gathering/ armies.

The hillwalker/ who Gerald/ reanimated and/ rescued/ refused/ to accept/ an
infusion/ when the operation/ had already been/ prepared.

When the hillwalker/ Gerald/ reanimated and/ rescued/ refused/ to accept/ an
infusion/ the operation/ had already been/ prepared.

The hillwalker/ Gerald/ reanimated and/ rescued/ refused/ to accept/ an
infusion/ when the operation/ had already been/ prepared.

When the hillwalker/ who Gerald/ reanimated and/ rescued/ refused/ to
accept/ an infusion/ the operation/ had already been/ prepared.

The director/ Gordon/ filmed and/ photographed/ began/ to plan/ a new
movie/ when the film company/ had/ serious financial problems.

When the director/ who Gordon/ filmed and/ photographed/ began/ to plan/ a
new movie/ the film company/ had/ serious financial problems.

The director/ who Gordon/ filmed and/ photographed/ began/ to plan/ a new
movie/ when the film company/ had/ serious financial problems.

When the director/ Gordon/ filmed and/ photographed/ began/ to plan/ a new
movie/ the film company/ had/ serious financial problems.

When the person/ who Geoffrey/ phoned and/ recruited/ asked/ to discuss/ the
details/ nobody seemed/ to be listening.

The person/ who Geoffrey/ phoned and/ recruited/ asked/ to discuss/ the
details/ when nobody seemed/ to be listening.

When the person/ Geoffrey/ phoned and/ recruited/ asked/ to discuss/ the details/ nobody seemed/ to be listening.

The person/ Geoffrey/ phoned and/ recruited/ asked/ to discuss/ the details/ when nobody seemed/ to be listening.

While the colleague/ Thomas/ called and/ warned/ tried/ to escape/ the burning building/ the smoke/ became/ really suffocating.

The colleague/ Thomas/ called and/ warned/ tried/ to escape/ the burning building/ while the smoke/ became/ really suffocating.

While the colleague/ who Thomas/ called and/ warned/ tried/ to escape/ the burning building/ the smoke/ became/ really suffocating.

The colleague/ who Thomas/ called and/ warned/ tried/ to escape/ the burning building/ while the smoke/ became/ really suffocating.

The lady/ Raymond/ selected and/ appointed/ planned/ to change/ the company's structure/ when the workers/ decided to go/ on strike.

When the lady/ who Raymond/ selected and/ appointed/ planned/ to change/ the company's structure/ the workers/ decided to go/ on strike.

The lady/ who Raymond/ selected and/ appointed/ planned/ to change/ the company's structure/ when the workers/ decided to go/ on strike.

When the lady/ Raymond/ selected and/ appointed/ planned/ to change/ the company's structure/ the workers/ decided to go/ on strike.

The pensioner/ who Victoria/ contacted and/ invited/ refused/ to attend/ the concert/ after the musicians/ decided/ not to play/ the next evening.

After the pensioner/ Victoria/ contacted and/ invited/ refused/ to attend/ the concert/ the musicians/ decided/ not to play/ the next evening.

The pensioner/ Victoria/ contacted and/ invited/ refused/ to attend/ the concert/ after the musicians/ decided/ not to play/ the next evening.

After the pensioner/ who Victoria/ contacted and/ invited/ refused/ to attend/ the concert/ the musicians/ decided/ not to play/ the next evening.

While the visitor/ Matthew/ disturbed and/ intimidated/ managed/ to resist/ the provocation/ other visitors/ could not handle/ the situation/ that well.

The visitor/ Matthew/ disturbed and/ intimidated/ managed/ to resist/ the provocation/ while other visitors/ could not handle/ the situation/ that well.

While the visitor/ who Matthew/ disturbed and/ intimidated/ managed/ to resist/ the provocation/ other visitors/ could not handle/ the situation/ that well.

The visitor/ who Matthew/ disturbed and/ intimidated/ managed/ to resist/ the provocation/ while other visitors/ could not handle/ the situation/ that well.

While the artist/ who Graham/ portrayed and/ described/ prepared/ to begin/ a new project/ the painting/ received/ very positive/ criticism.

The artist/ who Graham/ portrayed and/ described/ prepared/ to begin/ a new project/ while the painting/ received/ very positive/ criticism.

While the artist/ Graham/ portrayed and/ described/ prepared/ to begin/ a new project/ the painting/ received/ very positive/ criticism.

The artist/ Graham/ portrayed and/ described/ prepared/ to begin/ a new project/ while the painting/ received/ very positive/ criticism.

The stranger/ who Alisdair/ threatened and/ robbed/ hurried/ to reach/ a safe place/ when a policeman/ arrived.

When the stranger/ Alisdair/ threatened and/ robbed/ hurried/ to reach/ a safe place/ a policeman/ arrived.

The stranger/ Alisdair/ threatened and/ robbed/ hurried/ to reach/ a safe place/ when a policeman/ arrived.

When the stranger/ who Alisdair/ threatened and/ robbed/ hurried/ to reach/ a safe place/ a policeman/ arrived.

When the schoolgirl/ who Beverley/ offended and/ embarrassed/ failed/ to find/ the headmaster/ some other pupils/ started/ laughing.

The schoolgirl/ who Beverley/ offended and/ embarrassed/ failed/ to find/ the headmaster/ when some other pupils/ started/ laughing.

When the schoolgirl/ Beverley/ offended and/ embarrassed/ failed/ to find/ the headmaster/ some other pupils/ started/ laughing.

The schoolgirl/ Beverley/ offended and/ embarrassed/ failed/ to find/ the headmaster/ when some other pupils/ started/ laughing.

The adolescent/ Alison/ hugged and/ kissed/ started/ to open/ the shirt/ when the grandmother/ suddenly entered/ the room.

When the adolescent/ who Alison/ hugged and/ kissed/ started/ to open/ the shirt/ the grandmother/ suddenly entered/ the room.

The adolescent/ who Alison/ hugged and/ kissed/ started/ to open/ the shirt/ when the grandmother/ suddenly entered/ the room.

When the adolescent/ Alison/ hugged and/ kissed/ started/ to open/ the shirt/
the grandmother/ suddenly entered/ the room.

When the librarian/ Gillian/ faxed and/ emailed/ agreed/ to buy/ the book/ the
library/ had no money left/ for the rest/ of the year.

The librarian/ Gillian/ faxed and/ emailed/ agreed/ to buy/ the book/ when the
library/ had no money left/ for the rest/ of the year.

When the librarian/ who Gillian/ faxed and/ emailed/ agreed/ to buy/ the
book/ the library/ had no money left/ for the rest/ of the year.

The librarian/ who Gillian/ faxed and/ emailed/ agreed/ to buy/ the book/
when the library/ had no money left/ for the rest/ of the year.

While the villain/ who Veronica/ deceived and/ misled/ hoped/ to make/ a
profit/ the police/ already knew/ about the whole/ plan.

The villain/ who Veronica/ deceived and/ misled/ hoped/ to make/ a profit/
while the police/ already knew/ about the whole/ plan.

While the villain/ Veronica/ deceived and/ misled/ hoped/ to make/ a profit/
the police/ already knew/ about the whole/ plan.

The villain/ Veronica/ deceived and/ misled/ hoped/ to make/ a profit/ while
the police/ already knew/ about the whole/ plan.

The lawyer/ Jessica/ praised and/ congratulated/ managed/ to win/ another
case/ when the law firm/ was already/ quite wealthy.

When the lawyer/ who Jessica/ praised and/ congratulated/ managed/ to win/
another case/ the law firm/ was already/ quite wealthy.

The lawyer/ who Jessica/ praised and/ congratulated/ managed/ to win/
another case/ when the law firm/ was already/ quite wealthy.

When the lawyer/ Jessica/ praised and/ congratulated/ managed/ to win/
another case/ the law firm/ was already/ quite wealthy.

When the detective/ Deborah/ interrogated and/ accused/ decided/ to call/ a
lawyer/ the chief inspector/ had already/ arrived.

The detective/ Deborah/ interrogated and/ accused/ decided/ to call/ a lawyer/
when the chief inspector/ had already/ arrived.

When the detective/ who Deborah/ interrogated and/ accused/ decided/ to call/
a lawyer/ the chief inspector/ had already/ arrived.

The detective/ who Deborah/ interrogated and/ accused/ decided/ to call/ a
lawyer/ when the chief inspector/ had already/ arrived.

The workman/ who Kimberley/ ignored and/ avoided/ preferred/ to date/
another woman/ when it was clear/ that there were/ no chances at all/ to
succeed.

When the workman/ Kimberley/ ignored and/ avoided/ preferred/ to date/
another woman/ it was clear/ that there were/ no chances at all/ to succeed.

The workman/ Kimberley/ ignored and/ avoided/ preferred/ to date/ another
woman/ when it was clear/ that there were/ no chances at all/ to succeed.

When the workman/ who Kimberley/ ignored and/ avoided/ preferred/ to date/
another woman/ it was clear/ that there were/ no chances at all/ to succeed.

Appendix B: Materials used in Experiments 5-6

The list below shows the three versions of each of the 30 experimental items used in Experiments 5-6. The order of the three versions indicates which list each version of the item belongs to: The first version belongs to list 1, the second to list 2, the third to list 3. Slashes indicate the boundary between experimental segment and spill-over segment in Experiment 5. In Experiment 6, only the experimental segments were shown; the spill-over segments were not part of the questionnaire.

David baked the rolls during the break/ because many customers were waiting.

David during the break baked the rolls/ because many customers were waiting.

David baked during the break the rolls/ because many customers were waiting.

Christine after the meeting checked the article/ but overlooked some mistakes.

Christine checked after the meeting the article/ but overlooked some mistakes.

Christine checked the article after the meeting/ but overlooked some mistakes.

Thomas repaired before the weekend the computer/ but forgot the printer.

Thomas repaired the computer before the weekend/ but forgot the printer.

Thomas before the weekend repaired the computer/ but forgot the printer.

Maria after the speech opened the door/ when the bomb exploded.

Maria opened after the speech the door/ when the bomb exploded.

Maria opened the door after the speech/ when the bomb exploded.

Barbara entered during the first act the stage/ but was very nervous.

Barbara entered the stage during the first act/ but was very nervous.

Barbara during the first act entered the stage/ but was very nervous.

Rambo defended the village for several hours/ but many were killed.

Rambo for several hours defended the village/ but many were killed.

Rambo defended for several hours the village/ but many were killed.

Peter painted the picture during the exhibition/ but used the wrong paint.

Peter during the exhibition painted the picture/ but used the wrong paint.

Peter painted during the exhibition the picture/ but used the wrong paint.

Michael followed for a few minutes the lecture/ while the lecturer explained a theory.

Michael followed the lecture for a few minutes/ while the lecturer explained a theory.

Michael for a few minutes followed the lecture/ while the lecturer explained a theory.

Frank during the match injured the goalkeeper/ but was not penalized.

Frank injured during the match the goalkeeper/ but was not penalized.

Frank injured the goalkeeper during the match/ but was not penalized.

Beckham after the break spoiled the opportunity/ but the spectators
applauded.

Beckham spoiled after the break the opportunity/ but the spectators
applauded.

Beckham spoiled the opportunity after the break/ but the spectators
applauded.

Federer won the match within an hour/ but remained very modest.

Federer within an hour won the match/ but remained very modest.

Federer won within an hour the match/ but remained very modest.

Anna opened after the Christmas dinner the present/ while the family
watched.

Anna opened the present after the Christmas dinner/ while the family
watched.

Anna after the Christmas dinner opened the present/ while the family
watched.

Daniel fed after a quick breakfast the child/ while the mother slept.

Daniel fed the child after a quick breakfast/ while the mother slept.

Daniel after a quick breakfast fed the child/ while the mother slept.

Dennis defended the minister during the press conference/ but it was already too late.

Dennis during the press conference defended the minister/ but it was already too late.

Dennis defended during the press conference the minister/ but it was already too late.

Jennifer before the party bought the skirt/ but regretted it later.

Jennifer bought before the party the skirt/ but regretted it later.

Jennifer bought the skirt before the party/ but regretted it later.

Sandra greeted after the speech the guests/ but was not very polite.

Sandra greeted the guests after the speech/ but was not very polite.

Sandra after the speech greeted the guests/ but was not very polite.

Tim during the night watched the road/ while all the other guards slept.

Tim watched during the night the road/ while all the other guards slept.

Tim watched the road during the night/ while all the other guards slept.

Mark increased the payment after the agreement/ but many employees were dissatisfied.

Mark after the agreement increased the payment/ but many employees were dissatisfied.

Mark increased after the agreement the payment/ but many employees were dissatisfied.

Walter left during the concert the hall/ because of the loud music.

Walter left the hall during the concert/ because of the loud music.

Walter during the concert left the hall/ because of the loud music.

Arnold transferred the money before the tax assessment/ because of the tax advantages.

Arnold before the tax assessment transferred the money/ because of the tax advantages.

Arnold transferred before the tax assessment the money/ because of the tax advantages.

Laura before the exam explained the problem/ but the students were simply bored.

Laura explained before the exam the problem/ but the students were simply bored.

Laura explained the problem before the exam/ but the students were simply bored.

Fred during the meeting condemned the plans/ although the advisors protested.

Fred condemned during the meeting the plans/ although the advisors protested.

Fred condemned the plans during the meeting/ although the advisors protested.

Sarah insulted after the meal the chef/ but the other guests liked the food.

Sarah insulted the chef after the meal/ but the other guests liked the food.

Sarah after the meal insulted the chef/ but the other guests liked the food.

Karl repaired the oven after a huge dinner/ before he left.

Karl after a huge dinner repaired the oven/ before he left.

Karl repaired after a huge dinner the oven/ before he left.

Bert watched the movie after the party/ but was quite tired.

Bert after the party watched the movie/ but was quite tired.

Bert watched after the party the movie/ but was quite tired.

Alex after the decision fought the politicians/ but the battle was already lost.

Alex fought after the decision the politicians/ but the battle was already lost.

Alex fought the politicians after the decision/ but the battle was already lost.

Felix stated during the show the answer/ but nobody noticed the hint.

Felix stated the answer during the show/ but nobody noticed the hint.

Felix during the show stated the answer/ but nobody noticed the hint.

Benjamin accepted during the interview the defeat/ but the fans cheered.

Benjamin accepted the defeat during the interview/ but the fans cheered.

Benjamin during the interview accepted the defeat/ but the fans cheered.

Susanne during the lunch break condemned the behaviour/ but the pupils laughed.

Susanne condemned during the lunch break the behaviour/ but the pupils laughed.

Susanne condemned the behaviour during the lunch break/ but the pupils laughed.

Robert defended the title for several months/ but the coach was still not satisfied.

Robert for several months defended the title/ but the coach was still not satisfied.

Robert defended for several months the title/ but the coach was still not satisfied.

Appendix C: Materials used in Experiment 7

The list below shows the materials used in Experiment 7. While basically similar to the materials used in Experiments 5 and 6, all optionally intransitive verbs were substituted by obligatorily transitive verbs. In a few cases, changing the verb also made it necessary to change the subsequent direct object and/or the spill-over segment. As in Appendixes A and B, the order of the three conditions represents the list each version of the sentence belongs to.

David fixed the microwave during the break because many customers were waiting.

David during the break fixed the microwave because many customers were waiting.

David fixed during the break the microwave because many customers were waiting.

Christine after the meeting modified the article but overlooked some mistakes.

Christine modified after the meeting the article but overlooked some mistakes.

Christine modified the article after the meeting but overlooked some mistakes.

Thomas took before the weekend the computer but forgot the printer.

Thomas took the computer before the weekend but forgot the printer.

Thomas before the weekend took the computer but forgot the printer.

Maria after the speech received the award when the bomb exploded.

Maria received after the speech the award when the bomb exploded.

Maria received the award after the speech when the bomb exploded.

Barbara amazed during the first act the audience but was very nervous.

Barbara amazed the audience during the first act but was very nervous.

Barbara during the first act amazed the audience but was very nervous.

Rambo protected the village for several hours but many were killed.

Rambo for several hours protected the village but many were killed.

Rambo protected for several hours the village but many were killed.

Peter sold the picture during the exhibition but used the wrong currency.

Peter sold the exhibition painted the picture but used the wrong currency.

Peter sold during the exhibition the picture but used the wrong currency.

Michael ignored for a few minutes the lecture while the other students slept.

Michael ignored the lecture for a few minutes while the other students slept.

Michael for a few minutes ignored the lecture while the other students slept.

Frank during the match injured the goalkeeper but was not penalized.

Frank injured during the match the goalkeeper but was not penalized.

Frank injured the goalkeeper during the match but was not penalized.

Beckham after the break spoiled the opportunity but the spectators cheered.

Beckham spoiled after the break the opportunity but the spectators cheered.

Beckham spoiled the opportunity after the break but the spectators cheered.

Federer defeated the challenger within an hour but remained very modest.

Federer within an hour defeated the challenger but remained very modest.

Federer defeated within an hour the challenger but remained very modest.

Anna discovered after the Christmas dinner the present while the family watched.

Anna discovered the present after the Christmas dinner while the family watched.

Anna after the Christmas dinner discovered the present while the family watched.

Daniel punished after the meal the child while the mother slept.

Daniel punished the child after the meal while the mother slept.

Daniel after the meal punished the child while the mother slept.

Dennis supported the minister during the press conference but it was too late.

Dennis during the press conference supported the minister but it was too late.

Dennis supported during the press conference the minister but it was too late.

Jennifer before the party bought the skirt but regretted it later.

Jennifer bought before the party the skirt but regretted it later.

Jennifer bought the skirt before the party but regretted it later.

Sandra amused after the speech the guests but was not very polite.

Sandra amused the guests after the speech but was not very polite.

Sandra after the speech amused the guests but was not very polite.

Tim during the night blocked the road while all the other guards slept.

Tim blocked during the night the road while all the other guards slept.

Tim blocked the road during the night while all the other guards slept.

Mark awarded the pay rise after the agreement but many employees were angry.

Mark after the agreement awarded the pay rise but many employees were angry.

Mark awarded after the agreement the pay rise but many employees were angry.

Walter alarmed during the concert the police because of the loud music.

Walter alarmed the police during the concert because of the loud music.

Walter during the concert alarmed the police because of the loud music.

Arnold got the money after the tax assessment because of the tax advantages.

Arnold after the tax assessment got the money because of the tax advantages.

Arnold got after the tax assessment the money because of the tax advantages.

Laura before the exam described the problem but the students were bored.

Laura described before the exam the problem but the students were bored.

Laura described the problem before the exam but the students were bored.

Fred during the meeting praised the plans although the advisors protested.

Fred praised during the meeting the plans although the advisors protested.

Fred praised the plans during the meeting although the advisors protested.

Sarah recommended after the meal the chef but the other guests disliked the food.

Sarah recommended the chef after the meal but the other guests disliked the food.

Sarah after the meal recommended the chef but the other guests disliked the food.

Karl damaged the oven after a huge dinner before the guests left.

Karl after a huge dinner damaged the oven before the guests left.

Karl damaged after a huge dinner the oven before the guests left.

Bert enjoyed the movie after the party but was quite tired.

Bert after the party enjoyed the movie but was quite tired.

Bert enjoyed after the party the movie but was quite tired.

Alex after the decision criticised the politicians but the battle was lost.

Alex criticised after the decision the politicians but the battle was lost.

Alex criticised the politicians after the decision but the battle was lost.

Felix stated during the show the answer but nobody noticed the hint.

Felix stated the answer during the show but nobody noticed the hint.

Felix during the show stated the answer but nobody noticed the hint.

Benjamin emphasized during the interview the defeat but the fans cheered.

Benjamin emphasized the defeat during the interview but the fans cheered.

Benjamin during the interview emphasized the defeat but the fans cheered.

Susanne during the lunch break condemned the behaviour but the pupils
laughed.

Susanne condemned during the lunch break the behaviour but the pupils
laughed.

Susanne condemned the behaviour during the lunch break but the pupils
laughed.

Robert held the title for several months but the coach was still not satisfied.

Robert for several months held the title but the coach was still not satisfied.

Robert held for several months the title but the coach was still not satisfied.